# A MANUAL OF PRACTICAL ANATOMY

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*A GUIDE TO THE DISSECTION OF THE HUMAN BODY*

BY

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*IN THREE PARTS*

PART III.—The Head and Neck

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# PREFACE

THE issue of this volume affords me the opportunity to express my thanks to Professor T. H. Bryce, F.R.S., for all the help he has given me in the preparation of this work. It was at his suggestion I commenced it, and not a little of the result is due to the kindly interest he has taken in it throughout; and I am in great debt to him for the trouble he has taken to read the text, and for the many suggestions he has made towards improvement. The illustrations are the work of Miss M. E. Rea and Mr A. K. Maxwell, both of whom I thank for their interest no less than for their skill.

T. W.

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# A Manual of Practical Anatomy

## VOL. III

## THE HEAD AND NECK

THE order of dissection recommended for the head and neck is as follows, and indicated in brackets is the number of days[1] students should allot to each region :—

[*The skeleton of the skull should be beside the dissector throughout the whole course of the dissection, and constant reference is to be made to it. If this be not done, much of the descriptions will be meaningless.*]

1. The body is placed in the lithotomy position. Dissection of the **superficial structures** of the **face** and the anterior part of the **scalp** (3).

2. The body is placed face downwards. Dissection of the posterior part of the **scalp** ; the upper part of the **posterior triangle** of the **neck** ; the **axial muscles** of the **back** ; the **suboccipital triangle** ; and the **spinal cord** (6).

3. The body is placed on its back. Dissection of the **subclavian triangle** and the **anterior triangle** of the neck (6).

4. Dissection of the **temporal** and **pterygoid regions** ; the **temporo-mandibular joint** (4).

5. Dissection of the **submaxillary region** (3).

6. Deep dissection of the **neck** ; the **great vessels** and **nerves** (4).

7. Removal of the **brain**. Dissection of the **dura mater** and the **cranial fossæ** (2).

8. Dissection of the **orbit** and the **eyeball** (3).

9. Dissection of the **ear** (2).

10. Dissection of the **prevertebral region** and the **vertebral joints** (3).

11. Dissection of the **mouth** and the **pharynx** (3).

12. Dissection of the **larynx** (2).

13. Dissection of the **nasal cavity** (3).

14. Dissection of the **brain**[1] (5).

[1] Saturdays and Sundays are not included. It is sometimes convenient to postpone the dissection of the brain to a following term.

## DISSECTION OF THE FACE

(The body is placed in the lithotomy position for three days, and during this time it is perfectly convenient for the dissectors of the head and neck to undertake the dissection of the superficial parts of the face and the anterior part of the scalp.)

**Surface Anatomy.**—In the first place, palpate the bridge of the nose which is formed by the **nasal bones.** These are to be followed downwards to their lower margins which form the anterior boundary of the bony nasal aperture. This opening is completed, as is to be observed on the skeleton of the skull, by the **maxillary bones,** on the **frontal processes** of which the nasal bones rest. The attachment of the **cartilages** of the **nose** to the margins of the aperture is to be defined. The finger is then to be passed along the **supraorbital margin,** over which is placed the **eyebrow,** a thickened fold of skin which carries hairs directed laterally. On the supraorbital margin, about the junction of its medial third and lateral two-thirds, the **supraorbital notch** is to be felt; it transmits the supraorbital vessels and nerve. Above the medial part of the supraorbital margin the **superciliary ridge,** more or less distinct, is to be sought. The **malar prominence** is easily defined, and from it the **zygomatic arch** is to be followed backwards to the ear. Above this arch is the region of the **temporal fossa.** The prominence of the chin should be palpated, and from there the finger is to be carried backwards along the lower margin of the mandible to its angle and then upwards along the posterior border of the ramus to the ear. A vertical line from the supraorbital notch should now be marked on the face, and on it, if firm pressure be exercised, the **infraorbital foramen** of the maxilla and the **mental foramen** of the mandible can be defined. The first is placed about a quarter of an inch below the infraorbital margin and transmits the infraorbital vessels and nerve; and the second lies midway between the upper and lower borders of the (adult) mandible and transmits the mental vessels and nerve. In the old and edentulous jaw it is at a higher level.

The skin is to be reflected from the face. An incision which commences as far back as possible on the scalp is to be carried forwards along the middle line of the forehead and the nose and the upper lip to the mouth; and a continuation of this incision is to be carried in the lower lip from the mouth to the chin. A circular incision should then be made round the margin of the bony orbit, the eyelids being left intact, and it should be prolonged

from the lateral angle of the eye backwards to the ear. A second circular incision should be made round the mouth along the red margin of the lips, and a transverse cut should be carried from the angle of the mouth to the angle of the jaw. The flaps of skin thus defined should now be carefully raised, the lowest flap being turned downwards to the lower border of the jaw; and while doing so it will be noted that inserted into the deep surface of the skin there are many of the fibres of the superficial **facial muscles.**

The muscles which are found on the face all belong to one or other of two groups, entirely different in their arrangement and function and distinct in their nerve supply. The one group comprises the **muscles of expression**, a series of thin sheets lying for the most part in the superficial fascia and connected to the deep surface of the skin. They are all supplied by the **facial** (seventh cranial) **nerve.** The other group includes the **muscles of mastication**, a series of massive muscles which are attached to the lower jaw and effect its movements. They are supplied by the **mandibular** (third) **division** of the **trigeminal** (fifth cranial) **nerve.** The **masseter** muscle, one of this group (Fig. 5), will be in part exposed, and lying on and behind it the **parotid gland,** covered by fascia, will be seen.

It is the **muscles of expression** alone which come under examination in the present dissection. They are, as already stated, thin sheets of muscle lying in the superficial fascia, and for the most part are so blended together that it is not practicable in the course of an ordinary dissection to define in detail the exact extent and attachments of each individual muscle. It is more important to recognise that they are arranged in sets around the openings of the face so that they may be described in the following groups (Fig. 5):—An **oral** group related to the mouth and forming the substance of the lips and cheeks; an **ocular** group related to the orbital opening and extending into the eyelids; and small **nasal** and **auricular** groups set respectively round the cartilaginous parts of the nose and the auricle. In addition to these groups there are thin sheets extending downwards on the neck, the **platysma myoides**, and upwards over the scalp, the **occipito-frontalis**; these two parts, however, of the facial musculature will be studied in later dissections.

It is most convenient to commence the study of the facial muscles with the **ocular group**, and at the same time to examine the structure of the eyelids. The **eyelids** (palpebræ) are two thin movable folds serving for the protection of the eyeball, the upper

lid being much the longer and the more movable. At their extremities the eyelids meet and form the **palpebral commissures,** while the points just within the junctions of the two lids are usually termed the medial and lateral **canthi.** The free margin of each lid is flat, except close to the medial canthus; there they become rounded, and bound a small semilunar depression named the **lacus lachrymalis** (Fig. 1). The flat portions of the rims carry the eyelashes along their anterior borders, while along their posterior borders the orifices of the **tarsal** (Meibomian) **glands** are to be seen; on the rounded parts of the lids there are neither

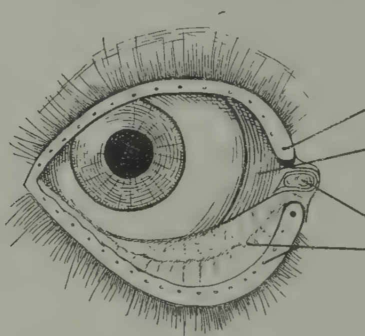


FIG. 1.

*The external anatomy of the eye.* The eyelids are shown drawn apart and the lower one is everted to show the appearance of the tarsal glands.

lashes nor glands. At the junction of the flat and rounded parts of each margin there is a little eminence, the **papilla lachrymalis,** perforated by a minute opening, the **punctum lachrymale** (Fig. 1). This is the mouth of the **lachrymal duct** which carries away the tears. A bristle should be passed into each orifice, when it will be found that the upper duct at first ascends and the lower at first descends, and then both run transversely to the **lachrymal sac** (see p. 9). The membrane which lines the deep surface of the eyelids is named the **conjunctiva.** It is reflected from the lids on to the anterior surface of the eyeball, the lines of reflection being known as the conjunctival **fornices.** On the margins of the lids it is continuous with the skin (Fig. 2). In connection with the conjunctiva there is to be observed the **caruncula lachrymalis,** a small reddish body which occupies the centre of the lacus lachrymalis. It contains modified skin glands, and a few small,

colourless hairs project from its surface. Lateral to the caruncula there is a small vertical semilunar fold of conjunctiva, the **plica semilunaris** (Fig. 1), which is the rudimentary representative in the human subject of the third eyelid or membrana nictitans found in birds, crocodiles, and other animals.

The skin, which is thin and loose, should be carefully reflected from the eyelids as far as their margins.

The student should now demonstrate for himself the **medial palpebral ligament**, a definite cord-like band which attaches the medial ends of the eyelids to the frontal process of the maxilla. It may be made tense and brought into prominence by pulling the eyelids forcibly towards the temple. There is a smaller and less distinct **lateral palpebral ligament** which passes from the lateral extremities of the lids to the frontal process of the malar bone.

The **ocular muscles** are now very apparent. The **orbicularis oculi** is that which surrounds the orbital margin and extends into the eyelids, while the **frontalis** lies above its upper border and extends upwards on the forehead. Both muscles should be cleaned with care, and any nerves found piercing them above the supra-orbital margin are to be preserved.

The **orbicularis oculi** (Fig. 5) lies in part in the substance of the eyelids, and in part, beyond them, round the margin of the orbital cavity. It consists of a continuous layer of fibres arranged concentrically, but it will be noted at once that the part which lies in the eyelids (palpebral portion) is thinner and its fibres paler in colour and finer in texture than the orbital portion which covers the orbital boundary. The fibres of the palpebral part sweep between the medial and lateral palpebral ligaments, and form under the skin a layer of uniform thickness except close to the bulbs of the eyelashes where there is a thickening, named the ciliary bundle (of Riolan). The orbital portion is much darker and coarser. Its fibres are attached on the medial side to the palpebral ligament, the neighbouring area of the frontal process of the maxilla and the medial angular process of the frontal bone, and sweep laterally in concentric loops. They reach upwards on to the forehead, downwards on to the cheek, and laterally into the temporal region, and in great part pass uninterruptedly round the orbital circumference. It is only in the eyebrow and the medial part of the lower lid that they are directly attached to the deep surface of the skin. (A third part of the muscle, the pars lachrymalis, will be described later.)

The **frontales muscles** (Fig. 5) are the anterior bellies of a musculo-tendinous layer of the scalp, the posterior bellies of which lie in the occipital region. Between the anterior and posterior bellies there is a broad aponeurotic tendon, which is named the galea aponeurotica or epicranial aponeurosis. The frontales muscles have little or no attachment to bone. On the forehead the muscles of the two sides are continuous across the middle line for a short distance, but when

followed upwards they diverge and pass into the galea aponeurotica. In a downward direction each frontalis muscle mingles with the fibres of the orbicularis oculi, but the most medial fibres are prolonged on to the root of the nose as the pyramidalis nasi muscle (Fig. 5).

The dissection of the **eyelids** should be completed at the present time. The thin palpebral parts of the orbicularis should be removed from the lids, care being taken in raising the muscle fibres to avoid injury to the underlying **palpebral fascia** and **tarsal plates**. These structures, lying in the same plane, form the framework of the eyelids. They are lined on their deep surface by the **conjunctiva**, which is closely adherent to the tarsal plates. The **medial palpebral ligament** should be defined by cutting away the fibres of the orbicularis which are attached to its upper and lower margins.

The **tarsal plates** are two thin but well-defined pieces of dense fibrous tissue, one being placed in each eyelid close to its free margin (Fig. 2). The upper is much the larger plate, and is half an oval in shape, the marginal border being relatively straight and somewhat thickened; the lower plate is only a narrow strip. The tarsal plates are connected to the bony margin of the orbit, above and below, by the **palpebral fascia**, a layer of fibrous tissue (Fig. 2). In the upper lid this fascia is blended with the underlying tendon of the levator palpebræ superioris, and is carried downwards on the anterior surface of the tarsal plate to which it is, in part, attached. Close to the orbital margin it is pierced by the supraorbital and supratrochlear nerves. In the lower lid the palpebral fascia is continuous with the lower margin of the tarsal plate (Fig. 2). At the lateral commissure of the eye the palpebral fascia is thickened and forms the **lateral palpebral ligament**, which connects the tarsi to the frontal process of the malar bone.

The **medial palpebral ligament** is a strong rounded band which connects the medial ends of the tarsi to the frontal process of the maxilla immediately in front of the groove for the lachrymal sac. If the ligament be carefully cleaned the lachrymal sac will be seen deep to it, while attached to its posterior surface there should be distinguished the fibres of the pars lachrymalis of the orbicularis oculi.

The palpebral fascia of the upper lid should now be removed to expose the glistening expanded tendon of the **levator palpebræ superioris**. This muscle arises within the orbital cavity and extends into the upper lid as a broad aponeurosis. It splits there into numerous fine lamellæ, the most anterior of which blend with the palpebral fascia, and, sweeping over the front of the tarsal plate, are ultimately fixed to the skin, while the most posterior are attached to the lower third of the face of the tarsal plate (Fig. 2). The upper margin of the tarsal plate is connected to the aponeurosis of the levator by a thin sheet of pale fibres, the "palpebral involuntary muscle," which may be considered to form an indirect insertion of the levator palpebræ superioris. Through

the agency of its fascial sheath, the levator palpebræ is attached to the superior fornix of the conjunctiva (Fig. 2). The levator muscle elevates the upper lid. It is supplied by the oculomotor (third) nerve.

At this stage the eyelids should be everted to display the tarsal

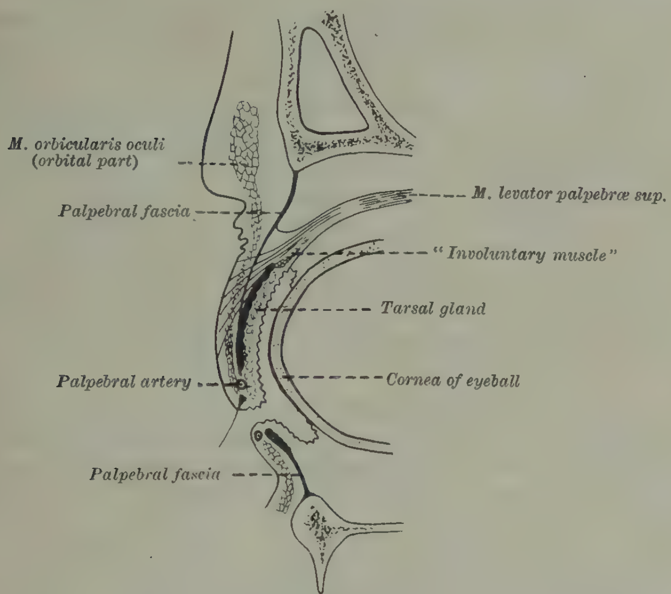


FIG. 2.

*Vertical section of the eyelids (diagrammatic).* The tarsal plates are represented in solid black; the difference in the attachment of the palpebral fasciæ to them in the upper and lower lids should be noted. The insertions of the levator palpebræ superioris should be followed out. The conjunctiva is shown as a waved line; its junction with the skin on the margin of the lid and its reflection on to the eyeball at the fornices are to be noted.

(Meibomian) **glands**. They lie in well-marked grooves on the deep surface of the tarsal plates, and are arranged in parallel rows vertical to the free margin of the lid. They are more numerous in the upper lid, and, as seen through the conjunctiva, appear as yellow granular streaks. They are long sebaceous glands, and their ducts open on the free margin of the lid posterior to the eyelashes (Fig. 2). Some large sweat glands also open on the margin of

the lid. They are known as the glands of Moll and when inflamed produce a "stye."

The following layers have now been exposed in the eyelids:—

Skin.
The palpebral part of the orbicularis oculi.
The tarsus and the palpebral fascia, and in the upper lid, the tendon of the levator palpebræ superioris.
The conjunctiva and between it and the tarsus the tarsal glands.

The **arteries** of the eyelids are the medial and lateral palpebral arteries, one vessel entering each lid at each of its extremities. The medial vessels are branches of the ophthalmic artery while the lateral arise from the lachrymal artery. These vessels anastomose with one another, forming an arterial arch in each lid close to its margin and between the orbicularis muscle and the tarsus. Most of the **veins** run medially and terminate at the medial commissure of the eye in the frontal and angular veins. The **sensory nerves** of the upper lid are derived from the supraorbital, supratrochlear, and infratrochlear branches of the ophthalmic division of the trigeminal nerve, and those of the lower lid come from the infraorbital branch of the maxillary division of the same nerve. The main trunks of the arteries and nerves will be secured later.

The **lachrymal apparatus** (Fig. 3) is also to be examined at the present time. It comprises the **lachrymal gland**, the secretion of which (the tears) is poured by the ducts of the gland into the lateral part of the superior fornix of the conjunctiva. The tears are then carried, by the movements of the upper eyelid, over the surface of the eyeball to the medial canthus, where any excess which has not been removed by evaporation passes through the **puncta lachrymalia** into the **lachrymal ducts**, and in them is conveyed to the **lachrymal sac**. From the lachrymal sac the **naso-lachrymal duct** leads into the lower part of the nose. When the secretion of the lachrymal gland is too abundant to be all drained away, it overflows from the lids as the tears.

The **lachrymal gland** is to be exposed by cutting through the palpebral fascia at the upper and lateral angle of the orbit. It will then be seen to lie in the orbital cavity under cover of the lateral angular process of the frontal bone.

The **lachrymal gland** is placed in the upper and lateral part of the orbit. It is about the size of a small almond and is yellowish in colour The upper surface is convex and is lodged in a depression on the orbital face of the frontal bone, while the lower surface is moulded to the convexity of the eyeball. The inferior part of the gland is almost completely separated from the rest by an expansion of the aponeurosis of the levator palpebræ superioris, and is closely adherent to the back of the upper eyelid, being covered only by the conjunctiva as it is reflected from the

lid on to the eyeball. The ducts of the gland vary in number—there are seldom more than twelve—and may be seen as fine white tubules if the anterior border of the gland be gently raised upwards. They open in a row into the upper lateral part of the conjunctival sac (Fig. 3).

The secretion of the lachrymal gland, having reached the medial canthus of the eye, is drained away by the lachrymal passages. These commence as the **lachrymal ducts** which open on the free margin of the lids at the **puncta lachrymalia**. Small bristles should again be passed through the puncta into the ducts and along the ducts into the **lachrymal sac**. The medial palpebral ligament will require to be cut away to expose the lachrymal sac which lies behind it.

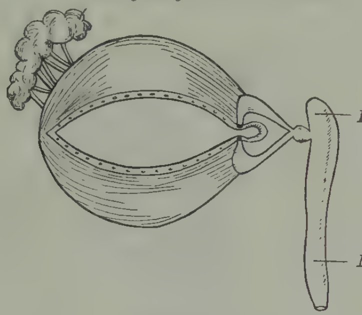


FIG. 3.

*The lachrymal apparatus (diagrammatic).*

The **lachrymal ducts** commence at the puncta lachrymalia on the summits of the lachrymal papillæ. The upper duct at first ascends and the lower duct at first descends, and then bending acutely on themselves both run laterally to the lachrymal sac into which they open. At the angles of bending the ducts are dilated into distinct ampullæ (Fig. 3).

The **lachrymal sac** (Fig. 3) is the upper dilated end of the passage which leads from the eye to the inferior meatus of the nose. Its upper end is closed and rounded and its lower end leads into the naso-lachrymal duct. The sac is lodged on the medial wall of the orbit, in the deep lachrymal groove formed by the lachrymal bone and the frontal process of the maxilla. It is covered in front by the medial palpebral ligament, while the pars lachrymalis of the orbicularis oculi muscle passes deep to it from its lateral side. The anterior wall of the sac should be opened and a probe passed down the naso-lachrymal duct into the nose. This duct will be seen in a later dissection, but it should be noted at present that it is about half an inch long, and that it is inclined backwards and laterally in its downward course.

The **pars lachrymalis** of the **orbicularis oculi** arises from the deep surface of the lateral part of the medial palpebral ligament and passes

medially behind the lachrymal sac to its insertion on the lachrymal crest of the lachrymal bone. It compresses the lachrymal sac and probably aids the flow of the tears into the nose.

The part of the orbicularis oculi which covers the medial part of the eyebrow should now be reflected downwards, very special care being taken not to cut away the branches of the supratrochlear nerve which underlie it. When this has been done the small **corrugator supercilii** muscle will be exposed (Fig. 5).

The **corrugator supercilii** arises from the medial part of the super-

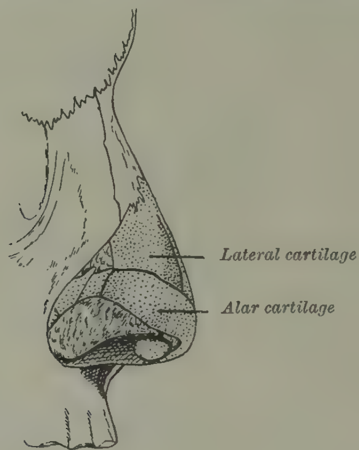


FIG. 4.

*The cartilages of the nose.* Behind the alar cartilage there are two small accessory cartilages.

ciliary ridge and running laterally and a little upwards is inserted with the orbicularis oculi into the skin over about the centre of the eyebrow. It draws the eyebrow downwards and towards the centre line, producing vertical furrows in the skin above the root of the nose as in frowning.

The **muscles** of the **nose** are now to be examined. They are small and feeble muscles, and often rudimentary and ill-defined, and the student should not endeavour to carry out a detailed dissection. They comprise the **pyramidalis nasi**, the **nasalis**, and the **depressor nasi** (Fig. 5).

The **pyramidalis nasi** is a continuation of the medial part of the frontalis. It descends over the nasal bone to end on the dorsum of the nose, where it blends with the transverse part of the nasalis and is inserted into the skin.

The **nasalis** muscle (Fig. 5) consists of two parts, transverse and alar. The transverse part arises from the maxilla close to the canine fossa and its fibres run upwards and medially across the cartilaginous part of the nose to end in a thin expanded aponeurosis which is continuous with that of the opposite side and with the pyramidalis nasi. The alar part consists of two feeble slips, one in front of the other, placed on the lateral surface of the nostril. The nasalis is partly concealed by the medial parts of the muscles of the upper lip.

The **depressor nasi** is a small muscle which arises below from the incisor fossa of the maxilla and passes upwards and medially to be inserted in part into the ala and in part into the septum of the nose.

The dissection of the nose should be completed by an examination of the **nasal cartilages**, which are to be exposed by stripping off the nasalis muscle. While doing this, care is to be taken to secure the **external nasal nerve** which emerges between the lower border of the nasal bone and the lateral nasal cartilage. It is accompanied by a small artery.

The cartilaginous framework of the nose consists of five cartilages, namely, the **septal cartilage** which will be studied in a later dissection, and the **lateral cartilage** and the **alar cartilage** on each side (Fig. 4).

The **lateral cartilage** is triangular in shape and lies immediately below the nasal bone, to the lower margin of which its upper border is attached. The cartilages of the two sides meet the anterior border of the septal cartilage in the middle line, while the lower border of the lateral cartilage is connected to the alar cartilage by fibrous tissue. The **alar cartilage** is folded round the front and side of the orifice of the nostril, but does not reach the nasal margin of the maxilla behind. The interval is filled with fibrous tissue in which there are usually one or two small accessory cartilages. In front, the bent part of the cartilage meets its neighbour of the opposite side and forms the point of the nose, and from it a narrow strip runs backwards along the lower margin of the septal cartilage, and acts as a support for the medial side of the nostril.

The **muscles** round the **mouth** (Fig. 5) serve best as a study of the arrangement of the facial musculature. Two sets of muscles may be clearly defined; namely (1) a circular muscle round the mouth, the **orbicularis oris**, which acts as a sphincter or closing muscle; and (2) a series of muscles which radiate in all directions from the sphincter and act as opening muscles. These opening muscles are arranged in two layers, a superficial and a deep, but all of them converge towards the orbicularis, and are so continued into it as to form part of its substance. They are, of course, bilateral muscles, and in health the muscles of the two sides antagonise one another; if the facial nerve of one side be injured, however, the balance is destroyed, and the mouth is drawn to the unaffected side.

The oral muscles should be dissected only on one side of the

face, and while they are being defined every care must be taken to preserve the vessels and nerves of the face, though these will be specially dissected on the other side. Commence by defining three muscles of the superficial group which radiate from the angle of the mouth (Fig. 5), namely, the **zygomaticus** which extends upwards, the **risorius** which lies transversely, and the **triangularis**

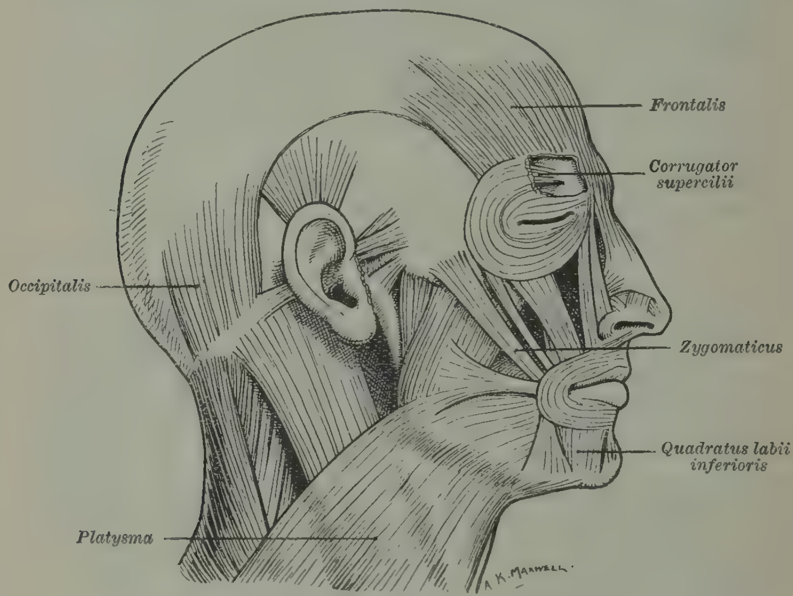


FIG. 5.

*The muscles of the face.* The student should identify the unnamed muscles of different groups while he is reading the text; namely, of the ocular group, the orbicularis oculi; of the nasal group, the pyramidalis nasi and the nasalis (two parts); of the oral group, the orbicularis oris, the risorius, the triangularis, and the quadratus labii superioris (three parts); and of the auricular group, the anterior, superior, and posterior auricular muscles.

which runs downwards. At the angle of the mouth they all more or less blend with one another and with the orbicularis oris.

The **zygomaticus** muscle (Fig. 5) is a slender band which arises from the upper border of the malar bone close to its junction with the zygomatic process of the temporal bone, and runs obliquely downwards to the angle of the mouth. It crosses the masseter muscle and then a mass of fat which fills the fossa in front of the masseter and close to its insertion it overlies the facial artery. Its fibres blend with those of the other muscles which reach the angle of the mouth and with the orbicularis and are inserted there into the skin of the upper and lower lips.

The **risorius** (Fig. 5) consists of a varying number of muscle bundles which arise from the fascia over the lower parts of the masseter muscle and the parotid gland, and running more or less transversely converge towards the angle of the mouth. It lies superficial to the platysma, but is often blended with some of the uppermost fibres of that muscle which join the orbicularis with it and are inserted into the skin at the junction of the lips.

The **triangularis** muscle (Fig. 5) arises from the oblique line on the body of the mandible and its fibres converge to be inserted with the orbicularis into both lips at the angle of the mouth.

The muscles of the more central parts of the upper and lower lips should now be defined; they are the **quadratus labii superioris** and the **caninus** in the upper lip, and the **quadratus labii inferioris** in the lower lip.

The **quadratus labii superioris** (Fig. 5) is a broad sheet, the origin of which extends along the infraorbital margin from the nose to the malar bone. At its origin there are three distinct parts, but these blend with one another and with the orbicularis oris at their insertion into the upper lip. The medial fibres form the **angular head**, which arises from the frontal process of the maxilla and is inserted below in part into the alar cartilage of the nose and in part into the upper lip. The **infraorbital head** comprises the intermediate fibres which are attached to the whole length of the infraorbital margin under cover of the orbicularis oculi, while the **zygomatic head** arises from the surface of the malar bone; both of these heads are inserted into the upper lip.

The **caninus** lies under cover of the quadratus superioris, which must be reflected to expose it. The interval between the two muscles is filled with fat in which the infraorbital vessels and nerves will be found and also, near the angle of the mouth, the facial artery. The muscle arises from the maxilla immediately below the infraorbital foramen, and at the angle of the mouth it blends with the other muscles attached there and with the orbicularis and is inserted into both lips.

The **quadratus labii inferioris** (Fig. 5) is a flat sheet of muscle which arises from the surface of the mandible between the symphysis and the mental foramen. It is continuous there with the platysma myoides. Its fibres end in the lower lip, blending there with the orbicularis. A good deal of fat is usually mingled with the muscle.

The **buccinator** muscle, one of the deep group of muscles, is the next to be examined. Its posterior part is overlaid by a mass of fat in the form of a remarkably well-defined pad, usually named the "suctorial pad." This is easily removed with the forceps. Under it a strong fascia invests the muscle. It is to be removed to display the muscle fibres, and while doing so the dissector may find superficial and deep to it some small **molar salivary glands** and sometimes one or two **buccal lymph glands**. The ducts of the salivary glands pierce the buccinator and open into the mouth.

The **buccinator** (Fig. 60) is a thin sheet of muscle which lies in the cheek in the interval between the upper and lower jaws to both of which

it is attached. Its origin is ⊂-shaped, comprising the alveolar processes of the maxilla and the mandible opposite the molar teeth, above and below, and the pterygo-mandibular ligament behind. The ligamentous attachment will be seen more distinctly in a later dissection. The fibres of the muscle run more or less transversely forwards to the angle of the mouth and are continued into the upper and lower lips in which they blend with the orbicularis oris. There is some decussation of the central

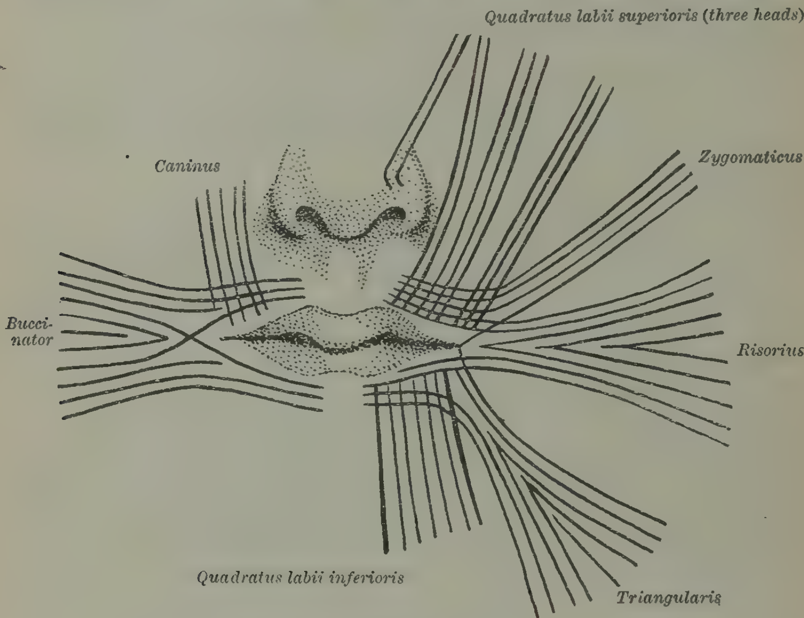


FIG. 6.

*A scheme of the arrangement of the muscles of the mouth.* The deeper muscles are shown on one side, and the more superficial muscles on the other side. Note that all of them take part in the formation of the orbicularis oris.

fibres, those from below passing into the upper lip and those from above into the lower lip.

The student will understand now that the **orbicularis oris** is a complex muscle (Fig. 6). It consists of a number of strata which surround the orifice of the mouth, and of these strata the deeper are formed by fibres proper to the lips and the superficial by fibres which run in different directions and are derived from the other oral muscles as has already been described. The fibres proper to the lips are oblique, passing between the deep surface of the skin and the mucous membrane of the mouth. They are connected in

the regions of the upper and lower lateral incisor teeth to the alveolar margins of the jaws, thus forming two small bundles in each lip which have been named the **musculi incisivi labii**.

The lips should be everted and the mucous membrane dissected

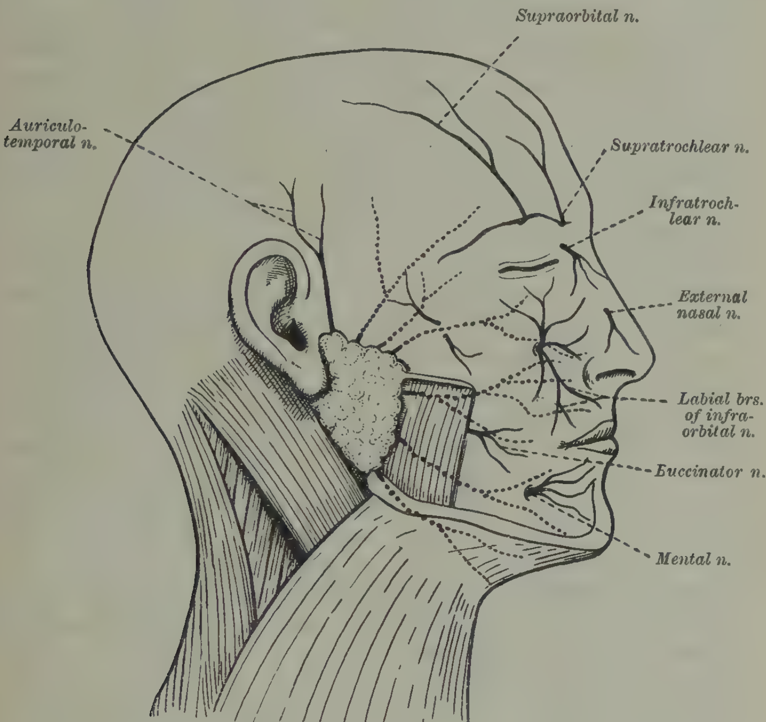


FIG. 7.

*A diagram of the nerves of the face.* The branches of the trigeminal nerve are in solid lines, those of the facial nerve in dotted lines. The zygomatic branches of the maxillary nerve are not named. The parotid gland and its duct are shown.

from their deep surface, cutting through the median fold (frenulum labii) which connects each lip with the appropriate jaw. On the deep surface of the membrane there are a number of small **labial salivary glands**, which the student can readily feel on himself as little ridges by pressing the tip of the tongue against the inner surface of the lips. The **incisivi muscles** can also be exposed, and if those of the lower lip be detached from the bone and

the lower lip further everted, the **mentalis** muscle will be displayed.

The **mentalis** is a distinct muscular bundle lying at the side of the frenulum of the lower lip. It arises from the incisive fossa of the mandible, under cover of the quadratus labii inferioris, and descends to be inserted into the skin of the chin, of which it is the elevator.

The **vessels** and **nerves** of the **face** are now to be studied. A complete dissection of them is to be made on the side on which the muscles are intact, these being cut through as much as is necessary to expose the different trunks. The **facial artery** and the **anterior facial vein** will be seen in parts of their course, but they should not be cleaned until the nerves, which are more liable to be cut, have been secured.

There are two sets of **nerves** distributed on the **face**, namely, the **motor nerves** of the **muscles of expression** and the **sensory nerves** of the skin of the face. The motor nerves to all the muscles of expression are branches of the **facial** (seventh cranial) **nerve**. They appear at the margins of the parotid gland and from there they spread over the face (Fig. 7). The sensory nerves are derived from the three divisions of the **trigeminal** (fifth cranial) **nerve**, each of which is distributed to more or less a precise area of the skin of the face (Fig. 7). The branches of the **ophthalmic** (first) division pass to the skin of the forehead and nose, those of the **maxillary** (second) division supply the skin over the upper jaw and the malar bone, and the **mandibular** (third) division is distributed over the mandible and the parotid gland. The branches of the fifth and seventh nerves anastomose with one another and form plexuses over the upper and lower jaws.

The fascia which covers the parotid gland is to be incised longitudinally from the zygoma to the angle of the lower jaw, immediately in front of the ear. If it then be raised from the gland, upwards, downwards, and forwards to its margins, the **branches** of the **facial nerve** will be easily secured as they emerge from below the gland; and the **duct** of the gland will be found at its anterior border about half an inch below the zygoma. Follow the duct across the masseter muscle. At its anterior border it turns at right angles, and having pierced the buccinator muscle opens into the mouth (Fig. 28). The **transverse facial artery** and **vein** and the **zygomatic** branches of the facial nerve are to be secured and followed forwards between the duct and the zygoma, and below the duct the **buccal** and **mandibular** branches of the nerve are to be dissected out. At the upper end of the

parotid gland the **superficial temporal vessels** are easily secured in their course upwards to the scalp (Fig. 8). The **auriculo-temporal nerve**, a branch of the third division of the fifth nerve, lies very close to them behind, while in front of them there are the **temporal** branches of the facial nerve. At the lower end of the parotid gland the **posterior facial vein** and the **cervical** branches of the facial nerve are to be secured, and it is then convenient to clean the **facial artery** and its branches and the **anterior facial vein.**

The **facial** (seventh cranial) **nerve**, having emerged from the skull, enters the parotid gland from behind and in its substance breaks into an irregular series of branches. These emerge from the margin of the gland above, in front, and below, and are named according to the region to which they are distributed (Fig. 7). They all terminate in the muscles of expression. The superficial muscles will require to be cut through to follow out the nerves. The **temporal** branches, which are of large size, emerge from the upper border of the gland, and sweeping over the zygoma in front of the superficial temporal artery are distributed to the orbicularis oculi, frontalis, and corrugator supercilii muscles. The **zygomatic** branches are also of large size. They pass forwards over the masseter muscle above the parotid duct, and supply the orbicularis oculi, the buccinator, and the muscles of the nose and upper lip. They anastomose with the infraorbital branch of the maxillary division of the fifth nerve below the lower eyelid, the plexus thus formed being named the infraorbital plexus. The **buccal** branches, which are smaller twigs, run towards the angle of the mouth. They supply the muscles which are inserted there and the buccinator. The **mandibular** branch runs along the axis of the lower jaw as far as the chin. It supplies the muscles of the lower lip and anastomoses with the mental branch of the mandibular division of the fifth nerve, which issues through the mental foramen. The **cervical** branch emerges from the lower end of the parotid gland and runs forwards below the angle of the jaw to the front of the neck. It will be seen in the dissection of the neck to supply the platysma muscle.

The **facial artery** is the main source of the blood supply of the face, but there are a large number of accessory vessels; namely, the **transverse facial artery** and a series of small arteries, **supraorbital, infraorbital, mental**, and others, which accompany the branches of the fifth nerve (Fig. 8). The latter will be exposed when the nerves are dissected.

The **facial artery** (Fig. 8) enters the face from the neck by crossing the lower border of the mandible just in front of the masseter muscle. From there it runs, in a tortuous manner and under cover of the platysma, to the angle of the mouth, and then ascends, deep to the zygomaticus and quadratus labii superioris, to the medial commissure of the eye. Its terminal part, however, is more superficial.

The **branches** of the artery arise from both its posterior and anterior aspects. The posterior branches are small. They pass backwards across the masseter and buccinator muscles and end in anastomoses with the transverse facial artery. The anterior branches are much larger. (1) The **inferior labial** branch arises below the angle of the

mouth and passes into the lower lip deep to the triangularis muscle. In the lip it lies close to the mucous membrane and runs to the middle line where it anastomoses with the opposite artery. There is almost constantly another branch of the facial artery in the lower lip, which runs medially at a lower level under cover of the quadratus inferioris. (2) The **superior labial** artery arises about the level of the angle of the mouth, and lying between the orbicularis oris and the

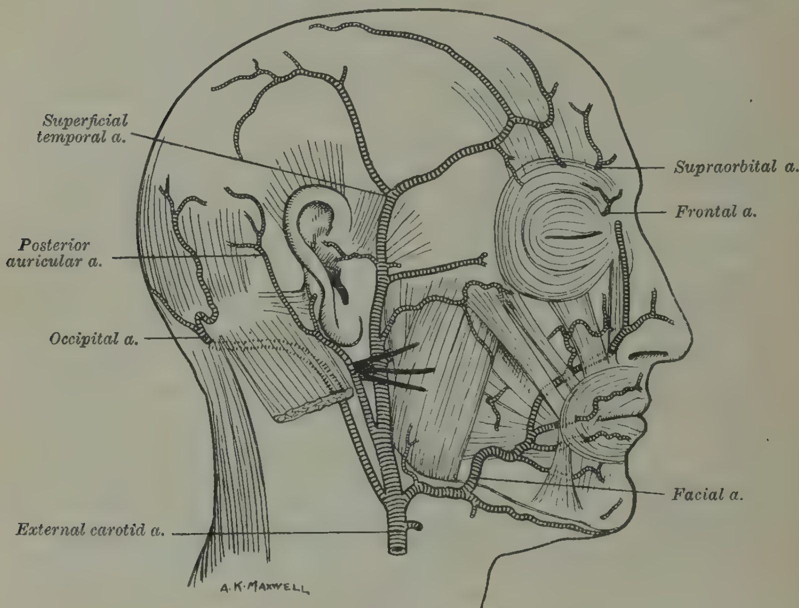


FIG. 8.

*The arteries of the face and scalp.* The facial artery should be followed across the face and its branches named ; the transverse facial, the buccinator, and the mental arteries are also shown. The facial (seventh) nerve is shown in heavy black lines crossing the upper part of the external carotid artery, the parotid gland not being represented.

mucous membrane runs to the middle line. It anastomoses with the vessel of the opposite side and gives off a septal branch which passes upwards to the lower and anterior part of the nasal septum. (3) The **lateral nasal** branch passes to the side of the nose. (4) The **angular** artery is the continuation of the facial trunk beyond the origin of the lateral nasal branch. It runs in the substance of the quadratus labii superioris to the medial angle of the eye where it anastomoses with branches of the ophthalmic artery.

The **transverse facial artery** (Fig. 8) is a branch of the superficial temporal artery. It emerges from the anterior border of the parotid

gland and runs forwards across the masseter between the zygoma and the parotid duct. It supplies the parotid gland and duct and anastomoses with the angular artery which it occasionally replaces.

The **anterior facial vein** commences at the medial commissure of the eye as the angular vein, which is formed by the union of the supraorbital and frontal veins from the forehead. It lies behind the facial artery which it follows downwards into the neck, but it is a much less tortuous vessel and is somewhat more superficial at its upper part. Its branches correspond with those of the facial artery, and it is joined at the anterior border of the masseter muscle by the **deep facial vein** which connects it with the venous plexus of the pterygoid space.

The **branches** of the **trigeminal** (fifth cranial) **nerve**, the sensory nerve of the face, should now be examined (Fig. 7). Most of them will have been secured already. Those of the **ophthalmic** (first) division are the **supraorbital, supratrochlear, infratrochlear,** and **lachrymal** nerves which perforate the palpebral fascia of the upper lid, and the **external nasal** nerve which emerges on the nose between the nasal bone and the lateral cartilage. The **maxillary** (second) division appears as a compact group of **infraorbital** nerves through the infraorbital foramen. They lie deep to the quadratus labii superioris which should be completely removed to expose them. There are also two small **zygomatic** branches, distributed over the malar region. The **mandibular** (third) division is represented by the **mental** nerve which issues through the mental foramen, the **auriculo-temporal** nerve which ascends in front of the ear, and the **buccinator** nerve which should be sought at the anterior border of the masseter and on the surface of the buccinator muscle. These nerves are all accompanied by small blood vessels which bear similar names.

The **supraorbital** nerve (Fig. 7) passes through the supraorbital notch and ascends on the forehead below the orbicularis and frontalis muscles. It divides into two branches, which extend backwards into the scalp almost as far as the lambdoidal suture. The **supratrochlear,** smaller than the preceding nerve, lies nearer the middle line. It turns round the orbital margin close to the bone and ascends under the orbicularis muscle, which it pierces to supply the skin of the forehead. The **lachrymal** nerve is a small twig which supplies the lachrymal gland and then pierces the palpebral fascia of the upper lid to the skin of which it is distributed. The **infratrochlear** nerve becomes superficial at the medial angle of the eye and supplies the skin in the neighbourhood and the caruncula lachrymalis. The **external nasal** nerve is distributed to the skin of the lower part of the nose.

The **infraorbital** nerve (Fig. 7) appears through the infraorbital foramen as a leash of branches which join with filaments of the facial nerve to form the infraorbital plexus. They then spread over the side of the nose (nasal branches) into the lower eyelid (inferior palpebral branches), and descend into the upper lip (superior labial branches). The **zygomatic** nerves, two in number, emerge on the face through

foramina in the malar bone. Both are small twigs. One passes upwards into the lower part of the temporal region, and the other is distributed over the malar prominence.

The **mental** nerve (Fig. 7) emerges at the mental foramen and divides into branches which are distributed over the chin and in the lower lip. They anastomose freely with the facial nerve. The **auriculo-temporal** nerve escapes from the upper border of the parotid gland, and ascends with the superficial temporal vessels over the zygoma into the temporal region where it is distributed. As it passes the auricle it gives branches to it and to the external meatus. The **buccinator** nerve ramifies over the buccinator muscle, supplying the mucous membrane on its deep surface and the skin of the cheek.

## DISSECTION OF THE BACK

(On the fourth day after the body is brought into the dissecting room it will be turned on its face and will remain so for six days. During this time the dissectors of the head and neck must dissect the **scalp** and part of the **posterior triangle** of the **neck**, and also, after the dissectors of the arm have removed the superficial muscles, they must complete the dissection of the **back** and examine the **spinal cord**.)

**Surface Anatomy.**—The **external occipital protuberance**, lying below the most posterior part of the skull, should be defined, and from it the **superior curved lines** of the occipital bones are to be followed laterally. The **mastoid process** of the temporal bone should be carefully palpated to determine its superficial outline and its size. Like the external occipital protuberance it is smaller in women than in men. It is not easy to define the **spinous processes** of the cervical vertebræ above the sixth and seventh, but these two should be determined with care.

A block should be placed under the chest to allow the neck to be flexed. A median incision, which should join the incision made from the front, is to be made from the vertex of the head to the seventh cervical spine, and from there a horizontal incision should be carried to the acromion process. An incision should also be made from the vertex of the head to the ear, and the flap of skin which is now outlined should be reflected laterally. Over the skull it will be found that the skin is intimately connected to the superficial fascia, and that these connections have to be cut through to allow it to be reflected.

The **superficial fascia** of the scalp is remarkably dense, tough, and fibrous, but on the neck it is thin and loose in texture, and through it there can usually be defined parts of two muscles. These are (1) the cervical part of the **trapezius**, which is attached to the external occipital protuberance and the posterior part of the

superior curved line; and (2) the upper end of the **sterno-mastoid,** which is attached to the mastoid process and the lateral part of the same curved line (Fig. 9). These muscles, and especially their opposed margins, are to be gradually defined, great care being exercised, especially by the student who is carrying out this dissection for the first time.

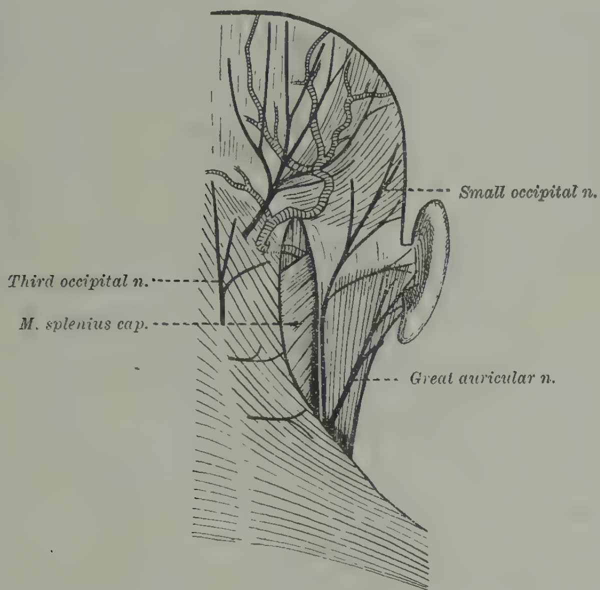


Fig. 9.

*Dissection of the scalp and the upper part of the posterior triangle of the neck.* The occipital artery and the great occipital nerve are shown on the scalp and the course of the artery across the semispinalis capitis muscle at the apex of the posterior triangle. The course and distribution of the posterior cutaneous branches of the fourth and fifth cervical nerves should be noted.

The **cutaneous nerves** of the neck and scalp have to be secured in the superficial fascia, while the muscles are being defined. They are derived from two sources, and may therefore be arranged in two groups: (1) The cutaneous branches of the **posterior divisions** of the second, third, fourth, and fifth **cervical nerves,** which perforate the trapezius muscle in linear series close to the middle line; and (2) the **small occipital** and **great auricular** branches of the **cervical plexus,** which emerge at the posterior border of the sterno-mastoid muscle (Fig. 9). Commence by securing the **great occipital nerve,**

which is the cutaneous branch of the posterior division of the second cervical nerve. It pierces the trapezius muscle about an inch below and lateral to the external occipital protuberance and runs upwards on to the scalp. Close to it the **occipital artery**, which may serve as a guide to the nerve, is to be dissected out of the superficial fascia of the scalp (Fig. 9). The **third occipital nerve**, which is the cutaneous branch of the posterior division of the third cervical nerve, will be found between the great occipital nerve and the middle line; it supplies the skin of the back of the neck and the lower part of the scalp. The cutaneous branches of the other posterior divisions will be found at a lower level; they pierce the trapezius close to the middle line and run laterally and somewhat downwards. When these nerves have been secured, the trapezius muscle may be safely cleaned right to its lateral margin. The **great auricular nerve** is usually easily found. It emerges from the posterior border of the sterno-mastoid muscle near the junction of its upper third and lower two-thirds, and ascends across the muscle towards the ear. The **small occipital nerve** will be found a little above and behind the great auricular. It runs upwards along the posterior border of the sterno-mastoid muscle to the scalp, where it is distributed on the lateral side of the great occipital nerve (Fig. 9).

When this dissection has been carried out the student should examine the **auricle**.

The **auricle** or **pinna** (the "ear" it is usually called) consists of a thin folded plate of yellow fibro-cartilage covered with skin, and is attached to the side of the head. The lateral surface is in general concave, but on it there are several well-marked elevations and depressions (Fig. 10). The margin, which is enrolled on itself in the greater part of its extent, is named the **helix**; on it a small tubercle (Darwin's tubercle) is often seen. The helix is continued below into the soft dependent part, the **lobule**, in which there is no fibro-cartilage. The deep fossa near the middle of the auricle, and which leads into the **external auditory meatus**, is named the **concha**. The curved prominence which bounds the concha behind is the **antihelix**. The prominence which projects in front of the concha is the **tragus**, while a similar projection below and behind it is the **antitragus**; the notch between these two is the **incisura intertragica**. The anterior end of the helix, the **crus helicis**, cuts into the concha from the front; and it will be noted that above this the antihelix divides into two **crura antihelicis**, which enclose between them a small triangular fossa.

The different parts of the auricle having been noted, the student should display the three **extrinsic muscles** which are attached to it. They are the **auriculares anterior, superior,** and **posterior,** and they should be brought into view and defined in the positions indicated by their names by carefully removing the superficial fascia. These muscles form the **auricular group** of the facial musculature (p. 3), and are supplied by the facial nerve. The posterior muscle receives its nerve from the **posterior auricular**

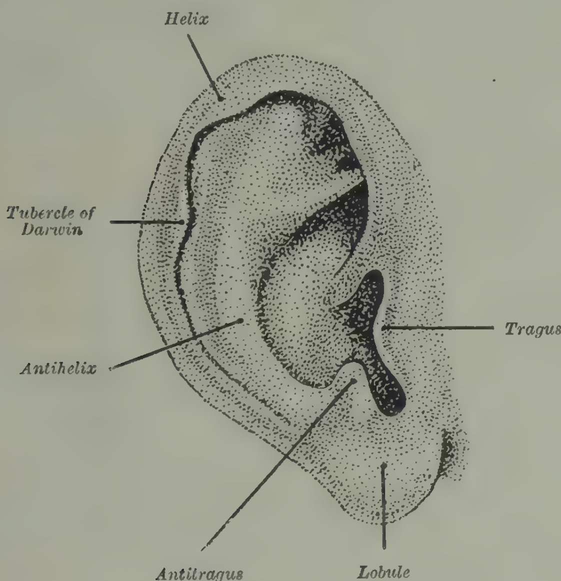


Fig. 10.

*The auricle.*

**branch,** which, with the accompanying **posterior auricular artery,** is to be secured behind the external meatus; the anterior and superior muscles are supplied by the temporal branches.

The skin should then be removed from the auricle to display the **auricular cartilage.** It extends throughout the auricle with the exception of the lobule, and corresponds with it in shape; and in addition it enters into the formation of the cartilaginous part of the external auditory meatus. Attached to the cartilage there are several small **intrinsic muscles,** also supplied by the facial nerve, and a series of **ligaments** which fix it in position; but in an

ordinary dissection no attempt need be made to define these structures.

The student must now make an examination of the structure of the scalp, that is, of the soft tissues which cover the vault of the skull. There are five layers to be considered, namely: (1) the **skin**; (2) the **superficial fascia**; (3) the **galea aponeurotica** or **epicranial aponeurosis**; (4) a layer of loose **areolar tissue**; and (5) the **pericranium**, which is the periosteum of the bones.

The **skin** is remarkably thick, and is firmly united to the underlying superficial fascia. It has been entirely removed. The **superficial fascia** is a tough and dense layer of fibro-fatty tissue. It is firmly adherent to the skin and to the galea aponeurotica by fibrous processes which pass through its thickness and are attached to them. In the fascia there are to be found the **nerves and blood vessels** of the scalp (Fig. 11).

The **cutaneous nerves** of the **scalp** in front of a line drawn between the ears have already been found to be derived from the three divisions of the trigeminal nerve; they are the **supraorbital, supratrochlear, zygomatic**, and **auriculo-temporal** nerves (Fig. 7). The nerves which are distributed to the scalp behind the ears are branches of the cervical spinal nerves. They are, from the middle line forwards to the ear, the **third occipital, great occipital, small occipital**, and **great auricular** nerves (Fig. 9). They have already been secured and are now to be followed out to their distribution.

The **third occipital** nerve is the medial branch of the posterior division of the third cervical nerve. It pierces the trapezius muscle close to the middle line of the neck, and extending upwards on the medial side of the great occipital nerve, it communicates with it and distributes fine branches to the neck and the lower part of the scalp.

The **great occipital** nerve (Fig. 9) is the chief cutaneous trunk of the posterior part of the scalp. It is the medial branch of the posterior division of the second cervical nerve and becomes superficial by piercing the upper part of the trapezius muscle. It breaks into a number of branches in the superficial fascia of the scalp and these are distributed as far forwards as the vertex of the head. It is accompanied by branches of the occipital artery.

The **small occipital** nerve is a branch of the cervical plexus. It is variable in size. It emerges from under cover of the sterno-mastoid muscle and runs upwards along its posterior border (Fig. 9). It enters the superficial fascia over the upper end of the muscle and supplies the lateral occipital and the mastoid regions of the scalp and the cranial surface of the auricle. It communicates with the great occipital and great auricular nerves.

The **great auricular** nerve is the largest cutaneous branch of the cervical plexus. It winds round the posterior border of the sterno-mastoid muscle, and courses vertically upwards over the muscle towards the angle of the lower jaw (Fig. 9). It divides there into branches which

are distributed over the mastoid process, to both surfaces of the lower part of the ear, and to the skin of the cheek over the parotid gland (facial branches).

The **arteries** which are distributed to the scalp are large, tortuous vessels, and numerous (Fig. 8). They enter the scalp at its margins, and passing into the superficial fascia are directed towards the vertex of the head. They anastomose freely with one another. On account of this arrangement large flaps of the scalp may be turned downwards from the vertex towards the margins of the head, and if they remain attached there they do not undergo necrosis since their blood supply is intact; and if they are replaced, healing readily occurs. The **occipital** artery supplies the back part of the scalp, the **posterior auricular** artery ascends behind the auricle, and the **superficial temporal** artery in front of it, while to the anterior part of the scalp there are distributed the **supraorbital** and **frontal** arteries which accompany the supraorbital and supratrochlear nerves. All of these trunks have already been located; they should now be traced to their distribution (Fig. 8).

The **occipital** artery arises in the front of the neck from the external carotid artery, and passes backwards under cover of the sterno-mastoid muscle. Near its termination it emerges in the interval between the sterno-mastoid and trapezius muscles or pierces the trapezius close to the occipital bone, and enters the superficial fascia of the scalp. It divides there into medial and lateral branches which supply the occipital and posterior parietal regions of the head and anastomose with the branches of the opposite vessel and with those of the posterior auricular and superficial temporal arteries. The medial branch gives off a meningeal twig which enters the skull through the parietal foramen and anastomoses with the middle meningeal artery.

The **posterior auricular** artery (Fig. 8) is a smaller branch of the external carotid stem. It reaches the interval between the mastoid process and the auricle, and there divides into branches which supply the auricle and the scalp over the insertion of the sterno-mastoid muscle. It is accompanied by the posterior auricular branch of the facial nerve.

The **superficial temporal** artery (Fig. 8) is also a branch of the external carotid artery. It emerges from the upper border of the parotid gland and crosses the zygomatic arch in front of the ear to enter the superficial fascia of the scalp. It divides there into a frontal and a parietal branch which ascend towards the vertex of the head, accompanied respectively by the temporal branches of the facial nerve and the auriculo-temporal nerve. These branches anastomose with each other and with the vessels in front of and behind them. The **transverse facial** artery, which was dissected on the face, arises from the temporal artery while it is still in the substance of the parotid gland, and there are now to be secured the following further branches (Fig. 8): (1) **Auricular** branches to the lateral surface of the auricle. (2) The **zygomatico-temporal** artery which runs along the upper border of the zygomatic arch to the lateral angle of the orbit. (3) The **middle temporal** artery which arises above the zygoma

and perforates the temporal fascia. It ends in the temporal muscle and anastomoses with the deep temporal arteries.

The **supraorbital** and **frontal** arteries (Fig. 8) are branches of the ophthalmic artery (p. 138), which arises from the internal carotid trunk within the cranium. They leave the orbit by winding round the supraorbital margin with the nerves which they accompany, and ascending over the forehead they anastomose with one another and with the temporal artery and supply the front part of the scalp.

The arrangement of the **veins** of the scalp corresponds more or less closely with that of the arteries, and they also anastomose freely with one another in the superficial fascia. There are two facts of clinical importance to be remembered about them, namely, that they communicate freely with the intra-cranial venous sinuses directly by anastomoses and also through the veins of the diplöe, and that their walls are adherent to the fibrous tissue of the superficial fascia. The latter fact accounts for the free hæmorrhage of wounds of the scalp and for the difficulty there is in tying the vessels at operation and in following them out in the course of dissection.

The **occipital** vein accompanies the occipital artery into the sub-occipital region where it terminates in a plexus of veins which will be dissected later. The **posterior auricular** vein is much larger than the corresponding artery. It leaves the artery at the base of the scalp, and crossing the upper part of the sterno-mastoid muscle, terminates in the external jugular vein (Fig. 22). The **superficial temporal** vein is formed by tributaries corresponding to the branches of the artery, which unite to form a single trunk above the zygoma. This is joined by the **middle temporal** vein, and the vessel thus formed, which is named the **posterior facial** vein, crosses the zygomatic arch and passes into the parotid gland. The **supraorbital** and **frontal** veins unite near the medial commissure of the eyelids to form the angular vein, which is the commencement of the anterior facial vein (Fig. 22). Before the union is effected the supraorbital vein communicates with the superior ophthalmic vein of the orbital cavity.

It is important that the student should remember the terminations of the **lymph vessels** of the scalp, though they cannot be displayed in the dissection. Those of the posterior part of the scalp end in lymph glands which lie superficial to the mastoid process and in the neighbourhood of the superior curved line of the occipital bone, while the vessels of the anterior part end in small glands which are embedded in the superficial surface of the parotid gland.

The **occipitalis muscle** should now be cleaned by the removal of the superficial fascia covering it. It arises as a broad flat band from the lateral two-thirds of the superior curved line of the occipital bone, and after a short course upwards and forwards ends in the galea aponeurotica. The remains of the superficial fascia

should then be removed to expose the **galea aponeurotica**, the connections and extent of which are to be examined. This is to be done by making a long median incision in the membrane and passing the handle of a scalpel under it anteriorly and posteriorly and from side to side.

The **galea aponeurotica** (epicranial aponeurosis) is a strong aponeurotic layer, which is connected in front to the frontales muscles and behind to the occipitales and between them to the external occipital protuberance and superior curved lines of the occipital bone. The membrane is thick and well-defined in the neighbourhood of the middle

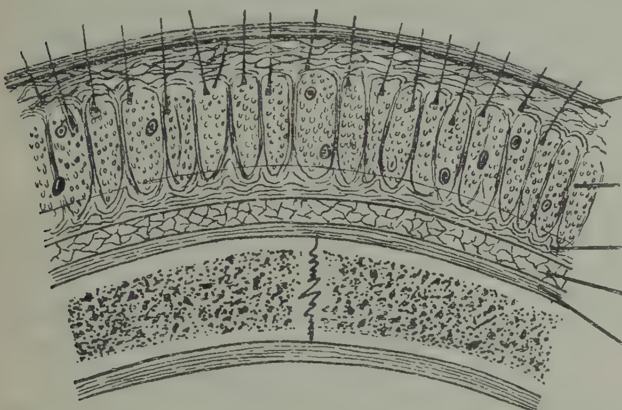


FIG. 11.

*The structure of the scalp in section (diagrammatic).* The blood vessels lie in the superficial fascia.

line of the skull, but at the sides it becomes thinner and descends for some distance over the temporal fascia. It is very closely connected to the superficial fascia, the fibrous processes of which can be separated from it only with the cutting edge of a scalpel, but it is so loosely attached to the underlying pericranium by the layer of areolar tissue that it glides freely over the vault of the skull. It may be thus moved by the alternate contractions of the frontales and occipitales muscles, and as it moves it necessarily carries with it the superficial fascia and the skin.

The fourth layer of the scalp is formed by the layer of loose **areolar tissue**. It will be seen, if a strip of the galea aponeurotica be raised, to be of fine texture, and to form a feeble connection between the galea and the underlying pericranium. It becomes much more dense, however, below the temporal ridges at the sides of the skull and over the supraorbital ridges in front, and it is on

this account that while effusions beneath the galea may raise the scalp from the greater part of the calvarium they do not tend to spread into the temporal regions or far on to the face. Such effusions, further, would not readily spread posteriorly beyond the superior curved lines owing to the attachment of the occipitales muscles and the galea aponeurotica to them.

A large area of the galea aponeurotica should now be removed to expose the **pericranium**, which is the name given to the periosteum on the exterior of the vault of the skull. It is a fairly strong layer of fibrous tissue which is readily separated from the bones it covers, except along the lines of the sutures through which it is continuous with the outer layer of the dura mater. Extravasation of blood under it, therefore, would tend to be limited by the sutures of the bone over which it occurred.

## THE NECK

(The student must now commence the dissection of the **posterior triangle** of the **neck**.)

The side of the neck is considered to extend from the middle line in front and to the anterior border of the trapezius muscle behind, and to be limited below by the clavicle and above by the lower border of the jaw, the mastoid process, and the superior curved line of the occipital bone. It is divided into anterior and posterior parts, the **anterior** and **posterior triangles** of the **neck**, by the sterno-mastoid muscle, which descends from the mastoid process and the superior curved line to the sternal end of the clavicle and the anterior surface of the manubrium sterni (Fig. 12).

The **posterior triangle** is thus bounded in front by the posterior border of the sterno-mastoid muscle and behind by the anterior border of the trapezius, while the base is formed by the clavicle between the attachments of these muscles. The apex of the triangle is at the superior curved line of the occipital bone, and here the cranial attachments of the trapezius and sterno-mastoid muscles may or may not meet one another. The triangle is covered by a layer of **deep cervical fascia**, not very strong and difficult to display as an entire sheet, but which is continuous with the fascia investing the bounding muscles in front and behind (Fig. 25); below, the fascia is attached to the clavicle and above, to the occipital bone. It and the thin superficial fascia covering it are to be gradually removed and the boundaries of the triangle cleanly defined; and

while doing so the following structures are to be secured and cleaned as far as is directed below.

(1) The **external jugular vein** which lies in the superficial fascia. It commences at the lower end of the parotid gland and passes downwards across the sterno-mastoid muscle to the lower and anterior corner of the posterior triangle (Fig. 13).

(2) The **cutaneous branches** of the **cervical plexus**, which enter the triangle from under the posterior border of the sterno-mastoid

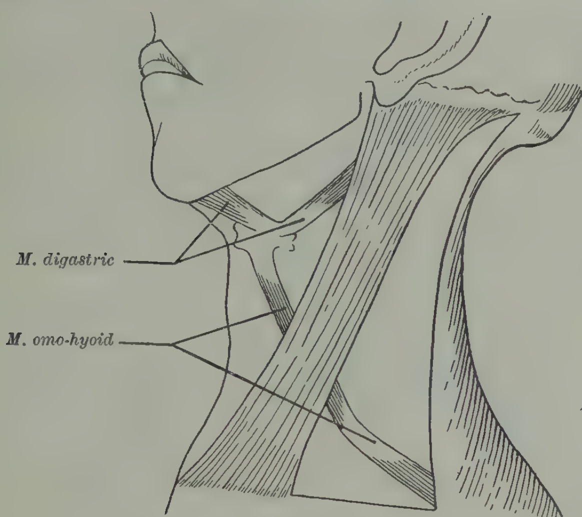


FIG. 12.

*Diagram of the division of the side of the neck into triangles.* The student should outline the boundaries of the different triangles, as described in the text, and name them.

muscle (Fig. 13). They may be grouped in three sets. (*a*) Ascending branches, the **great auricular** and **small occipital** nerves which have already been secured; (*b*) a transverse branch, the **transverse cervical** nerve, which emerges a little below the great auricular nerve and runs transversely across the sterno-mastoid muscle; it is to be followed only to the point where it crosses either superficial or deep to the external jugular vein; and (*c*) descending branches, the **supraclavicular** nerves, which run downwards for some distance under the deep fascia, and piercing it, cross the clavicle in three groups, anterior, middle, and posterior in position. The main trunks only are to be secured at present, and no attempt is to be made to follow them out in detail.

(3) While these nerves are being secured, the dissector will encounter a number of small **lymph glands** which lie in the superficial fascia along the posterior border and on the surface of the sterno-mastoid muscle.

(4) The **accessory** (eleventh cranial) **nerve**, which emerges at

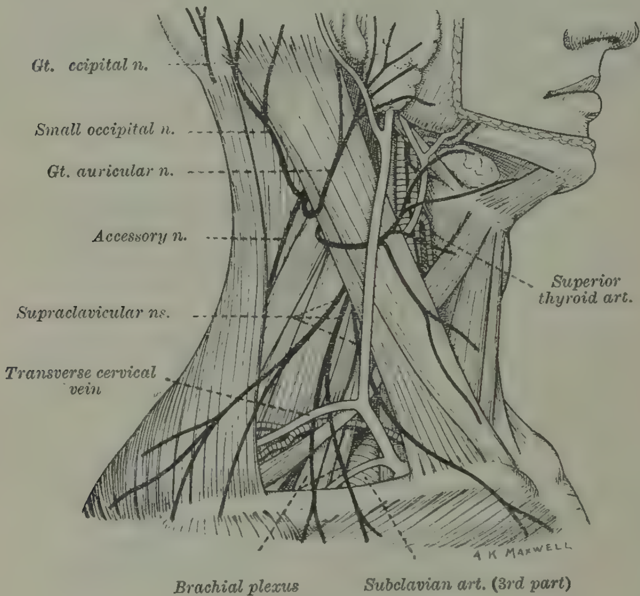


FIG. 13.

*Superficial dissection of the side of the neck.* The following unnamed structures are to be identified, and appropriately coloured. The external jugular and posterior auricular veins; transverse cervical nervė; the two bellies of the omo-hyoid muscle; the transverse cervical artery; the suprascapular vein; the carotid arteries; the hypoglossal and descendens hypoglossi nerves; the submaxillary and parotid glands; and the common facial vein and the facial artery.

the junction of the upper third and lower two-thirds of the posterior border of the sterno-mastoid muscle and in close relation with the small occipital nerve. It runs downwards and backwards across the triangle and disappears under the anterior border of the trapezius at the junction of its upper two-thirds and lower third (Fig. 13). As it crosses the triangle it is joined by branches from the third and fourth cervical nerves.

(5) The **posterior belly of the omo-hyoid muscle** is to be defined

as it crosses the lower part of the triangle (Fig. 13). It enters the triangle at its lower and posterior corner and runs upwards and forwards, only a short distance above the clavicle, to the posterior border of the sterno-mastoid muscle under which it disappears. It should in no way be disturbed in position at the present time. It is customary to divide the posterior triangle into two parts, which lie, respectively, above and below this muscle. The upper and by far the larger part is named the **occipital triangle**, and that below the omo-hyoid muscle is called the **subclavian triangle** (Fig. 12).

It is in the occipital triangle alone that all further dissection is to be carried out while the body lies on its face; for the subclavian triangle is more easily dissected and the relations of its parts more easily understood when it is dissected from the front.

The student should, therefore, revise the boundaries of the **occipital triangle** (Fig. 13). They are the posterior border of the sterno-mastoid in front, the anterior border of the trapezius behind, and the posterior belly of the omo-hyoid muscle below; and in it there have been exposed the superficial branches of the cervical plexus, the accessory nerve, and, at its apex, the occipital artery. There have now to be found, between the accessory nerve above and the omo-hyoid muscle below, the following further contents :—

(1) The **transverse cervical artery** which appears from under the upper border of the omo-hyoid muscle and runs upwards and laterally (Fig. 13).

(2) The upper part of the **brachial plexus**, which lies in the angle between the omo-hyoid and sterno-mastoid muscles (Fig. 13). It should on no account be further dissected at the present time.

The contents of the occipital triangle having been defined, an examination must be made of the structures which form its floor. These are a series of muscles, namely, from above downwards, the **splenius**, the **levator scapulæ**, and the **scalenus medius**, the fibres of all of which have a general direction downwards and backwards. At the apex of the triangle a small part of another muscle, the **semispinalis capitis**, is usually to be seen, and is readily recognised since its fibres run vertically (Fig. 9). These muscles are covered by a layer of deep cervical fascia.

## DISSECTION OF THE BACK

The dissectors of the arm will, by this time, have exposed and cleaned the **trapezius** muscle, and since in part it enters the present dissection, the dissectors of the head and neck should study again its attachments and relations.

The **trapezius** muscle is triangular in shape, its fibres converging towards a confined insertion from a long medial linear origin. It arises (in the region of the head and neck) from the external occipital protuberance and the medial third of the superior curved line of the occipital bone, from the ligamentum nuchæ and the seventh cervical spinous process; and (within the confines of the dissection of the arm) from the spinous processes of all the thoracic vertebræ and the supraspinous ligaments between them. It is inserted into the posterior border of the lateral third of the clavicle (upper fibres); into the medial edge of the acromion process (middle fibres); and into the upper border of the spine of the scapula as far medially as the tubercle at its root. This tubercle receives the insertion of a tendon which glides over the triangle at the medial end of the spine, being separated from it by a bursa, and into it the lower thoracic fibres of the muscle are continued. It should be noticed that a semi-oval tendinous aponeurosis is present in the origin of the muscle opposite the last cervical and the upper three or four thoracic vertebræ. This represents a substitution of tendon for muscle, an arrangement which probably has reference to the relatively small range of backward movement of the scapula in this locality.

In conjunction with the dissectors of the arm the trapezius muscle is to be divided by a vertical incision about one inch from the spines of the vertebræ, and having separated it from the occipital bone it is to be thrown laterally. On its deep surface there are to be secured and cleaned the nerves which supply it and the **superficial cervical artery**. The nerves are the **accessory nerve** and two or three **branches** from the **cervical plexus**, all of which join with one another and form a plexus on the deep surface of the muscle.

The **superficial cervical artery** is one of the two terminal branches of the transverse cervical artery, the division of which takes place at the anterior border of the levator scapulæ muscle; the other branch is the posterior scapular artery. The superficial cervical artery crosses the levator scapulæ muscle and is distributed on the under surface of the trapezius. (In a considerable number of subjects this artery is a direct branch of the thyreo-cervical trunk, and the posterior scapular artery arises independently from the third part of the subclavian artery. See under branches of subclavian artery.)

The part of the **accessory nerve** which supplies the trapezius consists of fibres which arise from the cervical part of the spinal cord (see p. 202). The nerve enters the posterior triangle of the neck from under the posterior border of the sterno-mastoid muscle at about the junction of its upper third and lower two-thirds, and at this point the small occipital nerve hooks round it from below. It runs downwards and backwards

across the triangle along the line of the levator scapulæ muscle, and in this part of its course it is joined by twigs from the third and fourth cervical nerves. It then disappears under the anterior border of the trapezius muscle, and on its deep surface breaks into branches which join with branches from the third and fourth cervical nerves to form the sub-trapezial plexus.

At this stage of the dissection there should be defined, for the benefit of the dissectors of the arm, the attachments of the **levator scapulæ** muscle and, passing deep to it from its anterior border, the **posterior scapular** branch of the transverse cervical artery and the **nerve** to the **rhomboid muscles.**

The **levator scapulæ** muscle arises by four tendinous slips from the posterior parts of the transverse processes of the upper four cervical vertebræ. These unite to form an elongated muscle which is inserted into the vertebral border of the scapula opposite the supraspinous fossa. It is supplied by branches of the third and fourth cervical nerves which descend on its surface.

The dissectors of the arm will complete their study of the muscles of the second layer of the back, the **levator scapulæ** and the **rhomboidius minor** and **major** muscles, by dividing them and turning them towards their scapular attachments. The dissectors of the thorax and abdomen will then associate themselves with the dissectors of the head and neck in an examination of the **superior** and **inferior posterior serrati muscles** and, after these are reflected, the **lumbo-dorsal fascia.**

The **posterior serrati** are muscles of the thoracic wall and are innervated from the anterior divisions of the thoracic nerves. They are two thin sheets, largely tendinous in their composition, and are placed one on the upper and one on the lower part of the posterior thoracic wall. The **superior** muscle arises from the lower part of the ligamentum nuchæ, the seventh cervical spine, and the spines of the upper two or three thoracic vertebræ, and runs downwards and laterally to be inserted into the four ribs below the first lateral to their angles. It is covered by the rhomboids and the trapezius. The **inferior** muscle is broader and stronger than the superior muscle. It arises from the spines of the lower two thoracic and upper two lumbar vertebræ and runs upwards and laterally to be inserted into the lower four ribs. It lies under cover of the latissimus dorsi and with it its tendon of origin is fused with the lumbo-dorsal fascia.

The **lumbo-dorsal fascia** covers the proper muscles of the spinal column and separates them from the muscles of the shoulder and arm, which form the first two layers of the muscles of the back. It is different in its arrangement in the thoracic and lumbar regions. The **thoracic** part, usually named the **vertebral aponeurosis,** is a thin fibrous layer which stretches transversely from the spinous processes of the vertebræ to the angles of the ribs. Above, it

passes deep to the serratus posterior superior and is continued into the neck, while below, it has blended with it the tendinous origin of the serratus posterior inferior and is continuous with the posterior layer of the lumbar portion. The **lumbar** part consists of three layers, posterior, middle, and anterior, which when traced laterally fuse with one another and give origin to the internal oblique and transversus muscles of the abdominal wall (Fig. 14). The **posterior** layer forms the dense aponeurotic covering of the spinal muscles, and blended with it are the aponeuroses of the latissimus dorsi and serratus posterior inferior. It is easily

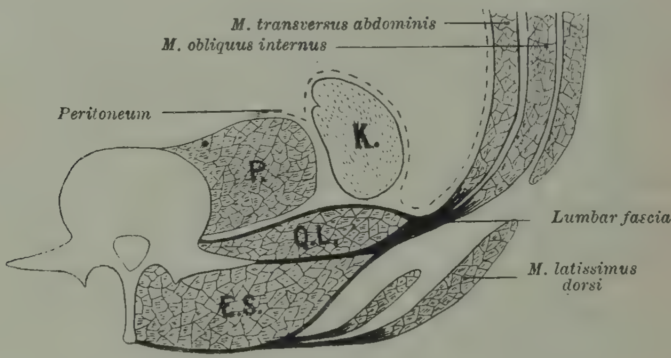


FIG. 14.

*The arrangement of the lumbar fascia as seen in transverse section (diagrammatic).*

K. Kidney. P. Psoas muscle, attached to a lumbar vertebra.
Q.L. Quadratus lumborum. E.S. Erector spinæ.

followed medially to its attachment to the tips of the lumbar spines and the sacrum, and downwards to its attachment along the iliac crest. It is to be incised longitudinally along the lateral margin of the spinal muscles, and this muscle mass being retracted medially, the **middle** layer of the lumbar fascia will be exposed. This layer, lying in front of the spinal muscles, passes to the tips of the transverse processes of the lumbar vertebræ, and in upward and downward directions it is fixed to the last rib and to the crest of the iliac bone. The middle layer is to be divided longitudinally, at its junction with the posterior layer, from the last rib to the iliac crest, and if it be then pushed towards the middle line with the handle of the scalpel the fibres of the **quadratus lumborum** muscle will be exposed. They run longitudinally from the crest

of the iliac bone to the last rib. The lateral border of this muscle projects about one inch beyond that of the spinal muscles, but if it be pushed medially the **anterior** layer of the lumbar fascia will be brought into view. It forms the anterior covering of the quadratus lumborum, and is attached medially to the roots of the transverse processes of the lumbar vertebræ, above to the twelfth rib, and below to the iliac crest. The dissectors of the thorax and abdomen will divide it to expose the infra-costal part of the kidney on its anterior surface (Vol. II., p. 27).

The dissectors of the head and neck must now commence a dissection of the **posterior spinal muscles.** These form a large mass on either side of the spinous processes, and extend, in vertical length, from the sacrum below to the occipital region of the skull above. This mass is divided into groups of individual muscles, but it is not expected that the student should memorise the intricate details of the origins and insertions of each of them; rather, he should understand their group formations and the actions they have on the vertebral column and the head. They are all supplied by the **posterior divisions** of the **spinal nerves.**

The **splenius** muscle is to be studied first. It is a thin flat sheet which arises from the lower part of the ligamentum nuchæ and the spinous processes of the upper thoracic vertebræ and is directed upwards and laterally. It is inserted in two parts: (1) the **splenius capitis** which reaches the occipital bone and the mastoid process; and (2) the **splenius cervicis** which is inserted into the transverse processes of the upper two or three cervical vertebræ. The surface of this muscle is to be carefully cleaned and its attachments demonstrated.

The **splenius** muscle arises from the lower half of the ligamentum nuchæ and from the spinous processes of the seventh cervical and the upper six thoracic vertebræ. It runs upwards and laterally, and divides into two parts named **capitis** and **cervicis.** The splenius capitis passes under cover of the sterno-mastoid muscle (Fig. 9), and is attached to the mastoid process of the temporal bone and the lateral part of the superior curved line of the occipital bone. The splenius cervicis is inserted by tendinous slips into the posterior parts of the transverse processes of the upper two or three cervical vertebræ.

The splenius muscle is to be divided close to its origin and turned upwards and forwards. The separation into the two parts will now be easily defined, and the attachment of the cervical slips medial to the origins of the levator scapulæ can be demonstrated. If the attachment of the sterno-mastoid muscle to the superior curved line of the occipital bone be

divided, the insertion of the cranial portion will be more fully exposed.

In the further dissection of the posterior spinal muscles, the student should study carefully the general descriptions which are given rather than attempt to memorise the numerical formula of which a statement of the origin and insertion of each individual muscle necessarily consists.

The spinal muscles may, first of all, be divided into three great groups; namely (1) the **erector spinæ** group; (2) the **multifidus spinæ** group; and (3) the **interspinales** and the **intertransversarii** muscles. These groups are to be studied separately.

The **erector spinæ** muscles are those whose fibres run more or less longitudinally and parallel to the vertebral column, so that when the muscles of the two sides act together they restore the vertebral column and the head to the vertical position after they have been bent forwards; they are muscles of extension to the erect position. If the muscles of one side act alone they produce a lateral flexion movement. This group is the most superficial of the three groups mentioned above, and is to be fully exposed by the removal of the posterior layer of the lumbo-dorsal fascia, to which the muscle fibres are adherent in the lumbar region. The erector spinæ will then be seen to commence below on the back of the sacrum where it is tendinous, narrow, and pointed, to be much larger in the lumbar region, where it is a thick fleshy mass, and when followed upwards to subdivide into three columns (Fig. 15). The lateral column, which separates first from the general mass, is the **ilio-costalis**, the middle and largest column is the **longissimus**, and the medial column, the least of the three and distinct only in the upper thoracic region, is the **spinalis**; and these columns gradually diminish in size as they ascend to be inserted into the ribs, the vertebræ, and the skull (Fig. 15).

The **erector spinæ** mass arises from the spines of the lumbar vertebræ and the supraspinous ligaments between them, from the dorsum of the sacrum and the posterior sacro-iliac ligaments, from the posterior part of the iliac crest, and from the deep surface of the posterior layer of the lumbar fascia. The muscle fibres form a large mass which splits in the upper lumbar region into three columns, the ilio-costalis, the longissimus, and the spinalis. Each of these columns consists, from below upwards, of separate segments, which are named from their position as follows (Fig. 15):—

| LATERAL COLUMN. | MIDDLE COLUMN. | MEDIAL COLUMN. |
|---|---|---|
| **Ilio-costalis.** | **Longissimus.** | **Spinalis.** |
| I. lumborum. | L. dorsi. | S. dorsi. |
| I. dorsi. | L. cervicis. | S. cervicis. |
| I. cervicis. | L. capitis. | |

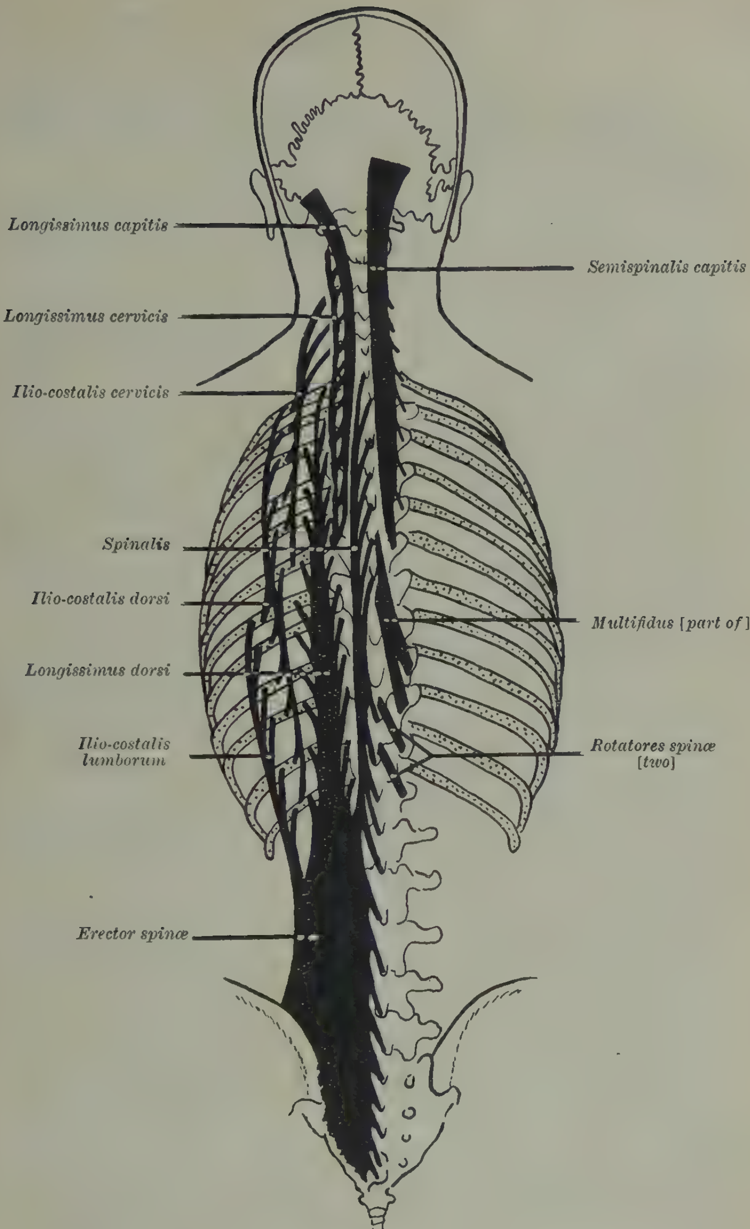


Fig. 15.

*Scheme of the arrangement of the spinal muscles of the back.* The longitudinal muscles (erector spinæ group) are shown on the left side, and the oblique muscles (multifidus spinæ group) on the right side.

The **ilio-costalis lumborum** is inserted by flattened tendons into the lower borders of the angles of the lower six or seven ribs. Between this muscle and the longissimus dorsi the lateral branches of the posterior divisions of the lower thoracic nerves make their exit.

The **ilio-costalis dorsi** arises by slender tendons from the upper borders of the angles of the lower six ribs medial to the tendons of insertion of the ilio-costalis lumborum, and is inserted by similar tendons into the angles of the upper six ribs and the back of the transverse process of the seventh cervical vertebra.

The **ilio-costalis cervicis** arises by four slips from the angles of the third, fourth, fifth, and sixth ribs medial to the tendons of the ilio-costalis dorsi, and is inserted into the posterior tubercles of the transverse processes of the fourth, fifth, and sixth cervical vertebræ. The dissector must evert the ilio-costalis dorsi to display it properly.

The **longissimus dorsi** possesses two rows of slips of insertion: (1) a medial row of tendinous slips attached to the accessory processes of the lumbar vertebræ and to the tips of the transverse processes of all the thoracic vertebræ; and (2) a lateral row of muscular slips attached to the posterior surface of the middle layer of the lumbar fascia, to the transverse processes of the lumbar vertebræ, and to the lower ten ribs between their tubercles and angles. The interval between the longissimus and the spinalis is often difficult to define in the upper thoracic region, and can only be determined by carefully removing the vertebral aponeurosis from the surface of the muscles.

The **longissimus cervicis** lies medial to the longissimus dorsi. It arises by long slender tendons from the transverse processes of the upper four thoracic vertebræ, and is inserted by similar tendons into the posterior tubercles of the transverse processes of the second to the sixth cervical vertebræ.

The **longissimus capitis** arises by tendons from the transverse processes of the upper four thoracic vertebræ and the articular processes of the lower four cervical vertebræ, and as a narrow fleshy ribbon ascends to be inserted into the posterior margin of the mastoid process under cover of the splenius capitis. Some care is required to separate its lower part from the longissimus cervicis.

The **spinalis dorsi** is intimately blended with the longissimus dorsi, on the medial side of which it is placed, and also with the semispinalis dorsi on which it lies. It may be regarded as arising from the spinous processes of the upper two lumbar and the lower two thoracic vertebræ, the origin being by tendinous slips. These unite to form a small muscle which is inserted by separate tendons into the spinous processes of the upper thoracic vertebræ, the number varying from four to eight.

The **spinalis cervicis** is an inconstant muscle and very variable, and not easily defined when it is present. It arises most commonly from the lower part of the ligamentum nuchæ, and the spinous process of the seventh cervical vertebra, and is inserted into the spinous processes of the second and third, and sometimes the fourth, cervical vertebræ.

The longissimus dorsi and the spinalis dorsi muscles are now to be cut away, when the second group of muscles, the **multifidus spinæ** group, will be exposed. This group comprises a series of muscles whose fibres run obliquely, arising from the transverse processes of one series of vertebræ, and being inserted into the

spinous processes of a higher series (Fig. 15). Their general direction is, therefore, upwards and medially, and they act as rotators of the vertebral column and its individual parts round a vertical axis when the muscles of one side contract; when both sides contract together they will assist the extensor muscles. The multifidus spinæ mass is subdivided into three layers according to the length and obliquity of its fibres. The most superficial layer is the least oblique, and its fibres cross over five or more vertebræ between their origin from the transverse processes below and their insertion into the spinous processes above. This layer is named the **semispinalis**, and of it there are three parts, the **semispinales dorsi, cervicis,** and **capitis.** The semispinalis capitis is fully exposed at the present time, and is to be cleaned and its attachments defined with some care; and while doing so the **occipital artery,** which crosses its upper part, and the medial branches of the posterior divisions of the upper cervical nerves, which pierce it close to the middle line, are to be preserved.

The **semispinalis capitis** (complexus muscle) lies in the back of the neck beneath the splenius muscle and medial to the longissimi cervicis and capitis. It arises by a series of tendons from the tips of the transverse processes of the upper six thoracic and the seventh cervical vertebræ, and from the articular processes of the fourth, fifth, and sixth cervical vertebræ. The tendons give place to a broad thick muscle which ascends to be inserted into the area between the superior and inferior curved lines of the occipital bone (Fig. 15). The most medial part of the muscle is more or less distinct from the general mass, and is usually named the "biventer cervicis," since it is intersected by an imperfect tendinous septum.

The semispinalis capitis is to be reflected, but before doing so the **occipital artery** should be studied in the further part of its course, which is now exposed. This vessel can be seen to emerge from under the mastoid process if the longissimus capitis muscle which covers it be divided and turned upwards; occasionally, however, the artery lies superficial to this muscle. From the mastoid process the occipital artery passes horizontally backwards, being covered by the splenius capitis and sterno-mastoid muscles and resting on the semispinalis capitis. Emerging from the posterior border of the sterno-mastoid muscle, it crosses the apex of the posterior triangle of the neck to reach its distribution on the scalp (Fig. 16).

The **branches** of the **occipital artery** in this part of its course are (1) **muscular** twigs to the surrounding muscles; (2) a **meningeal** branch which enters the skull through the mastoid foramen; and (3) the **descending cervical artery,** a vessel of some size, which runs to the

lateral border of the semispinalis capitis and there divides into superficial and deep branches. The superficial branch ramifies on the surface of the semispinalis capitis while the deep branch descends beneath that muscle to anastomose with the deep cervical artery. This anastomoses will be exposed when the muscle is reflected.

The semispinalis capitis is to be reflected by dividing it transversely about half an inch below its occipital attachment and turning it laterally. In doing so the nerves which enter it from the posterior divisions of the first and second cervical nerves should be sought. There is often some difficulty in performing this dissection neatly and at the same time preserving the structures which lie below the muscle. In its upper part it lies over the **suboccipital triangle** while below it covers the **semispinalis cervicis** muscle, a dense **fascia** being placed over these parts. In this fascia the dissector must define the **deep cervical artery**, which springs, on the front of the neck, from the costo-cervical branch of the subclavian artery, and reaches its present position by passing backwards between the transverse process of the seventh cervical vertebra and the neck of the first rib (p. 80). It ascends on the semispinalis cervicis to anastomose with the descending cervical branch of the occipital artery. The artery is accompanied by a large vein, or plexus of veins, which begins in the suboccipital triangle and ends in the vertebral vein on the front of the neck. It reaches this vein by turning forwards below the transverse process of the seventh cervical vertebra. The **great occipital nerve** is to be specially preserved, and the series of the medial branches of the posterior divisions of the cervical nerves behind it should be retained if possible. The **semispinales cervicis** and **dorsi** can now be examined.

The **semispinalis dorsi** consists of a series of thin muscular slips with long tendons of origin and insertion. They are attached below to the transverse processes of the sixth to the tenth thoracic vertebræ, and above to the spinous processes of the upper four thoracic and lower two cervical vertebræ.

The **semispinalis cervicis** lies under cover of the semispinalis capitis. It is much more muscular in its structure than the previous muscle. It arises from the transverse processes of the upper five thoracic vertebræ and is inserted into the spinous processes of the second to the fifth cervical vertebræ.

The second layer of the multifidus spinæ group of muscles will be exposed if the semispinales dorsi and cervicis be detached from the spinous processes and thrown laterally, and the erector spinæ mass be removed from the lumbar region. The fibres of this layer will be seen to be more oblique than those of the semispinales

muscles, and the bundles into which they are grouped to be shorter and to pass over two, three, or four vertebræ (Fig. 15). The whole mass of muscle which is thus arranged extends from the sacrum below to the axis above. It is named the **multifidus muscle**.

The **multifidus muscle** forms a thick fleshy mass in the sacral and lumbar regions. It arises there from the back of the sacrum and the posterior sacro-iliac ligaments, from the posterior superior iliac spine, and from the mammillary processes of the lumbar vertebræ. In the thoracic region it arises from the transverse processes of all the vertebræ, and in the cervical region from the articular processes of the lower four vertebræ. The most superficial fibres pass over three or four vertebræ, while the deepest are the shortest and pass over no more than two vertebræ ; they are all inserted into the spinous processes of the movable vertebræ as high as the axis.

The third and deepest layer of the oblique fibres is to be found only in the thoracic region, and will be exposed by cutting away the fibres of the multifidus muscle. It will then be seen to consist of small quadrate muscles which arise from the transverse processes and are inserted into the spinous processes of contiguous vertebræ. They are named the **rotatores spinæ** (Fig. 15).

The **rotatores spinæ** muscles are usually confined to the thoracic region, and are eleven in number on each side ; this number may be diminished, however, by the absence of one or more at the upper or lower end of the series. Each is a small quadrate muscle which arises from the root of the transverse process of one vertebra and is inserted into the lamina and the root of the spinous process of the vertebra immediately above.

The third group of the muscles of the back, the **interspinales** and the **intertransversarii**, are small muscles which extend between neighbouring movable vertebræ. Little time should be spent on their examination.

The **interspinales** are placed in pairs between the spinous processes of contiguous vertebræ, one lying on either side of the interspinous ligament. They are most distinct in the cervical region where they occupy each interspinous interval except that between the atlas and the axis. They are found only at the upper and lower parts of the thoracic region, but in the lumbar region they are well developed and connect all the vertebræ.

The **intertransversarii** are placed between the transverse processes of the vertebræ. They are best developed in the cervical region, but are not to be dissected there at present (see p. 164). In the thoracic region they are found only in the three or four lower spaces. In the lumbar region they are well defined muscles, and are arranged in pairs on each side ; one of each pair occupies the entire interspace between the transverse processes of the lumbar vertebræ, and the other passes from the mammillary process of one vertebra to the accessory process of the vertebra above.

At the upper part of the neck and under cover of the semispinalis capitis muscle (which has been reflected), there is a small triangular space named the **suboccipital triangle.** It is overlaid by a dense fibro-fatty tissue, which renders the dissection of the triangle somewhat difficult. This tissue, however, should be gradually cleared away, and while doing so the dissector should note the large number of small veins embedded in it. These form the **suboccipital venous plexus.**

The **suboccipital venous plexus** comprises a large number of small veins which occupy the suboccipital triangle, and are embedded in the covering fascia. They include branches from the occipital vein, numerous small veins from the muscles of the upper part of the neck, and tributaries which communicate with the veins of the vertebral canal. The plexus is drained partly by the radicles of the vertebral vein, and partly by the deep cervical vein, the latter of which has already been dissected in company with its artery.

As the fibrous tissue is cleared away, the muscles which bound the triangle will be brought into view. They are, the **obliquus capitis inferior** which bounds it below, and which is easily found since the great occipital nerve hooks round its lower border; the **obliquus capitis superior** which bounds it on the lateral side; and the **rectus capitis posterior major** muscle which forms its upper and medial boundary (Fig. 16). These muscles are to be cleaned and their attachments defined, and under the rectus capitis major muscle the small **rectus capitis posterior minor** is to be exposed (Fig. 16).

The **obliquus capitis inferior,** the larger of the two oblique muscles, arises from the apex of the spinous process of the axis and extends laterally and only slightly upwards to be inserted into the lower and back part of the transverse process of the atlas.

The **obliquus capitis superior** has a narrow origin from the upper surface of the transverse process of the atlas. It broadens considerably as it runs upwards and medially to be inserted into the occipital bone, lateral and deep to the semispinalis capitis.

The **rectus capitis posterior major** arises by a narrow pointed tendon from the spinous process of the axis. It becomes broader as it ascends, and is inserted into the lateral part of the inferior curved line of the occipital bone and the area immediately below. The muscles of the two sides diverge as they pass upwards, and in the interval between them the recti minores are seen.

The **rectus capitis posterior minor** arises by a narrow tendon from the tubercle on the posterior arch of the atlas, and widening as it ascends is inserted into the medial part of the inferior curved line of the occipital bone and the area between it and the foramen magnum.

While these muscles are being defined, the dissector should secure the small branches of the **suboccipital nerve** which supply

them. In the floor of the triangle there should then be exposed the **posterior arch** of the **atlas**, and above it the thin **posterior**

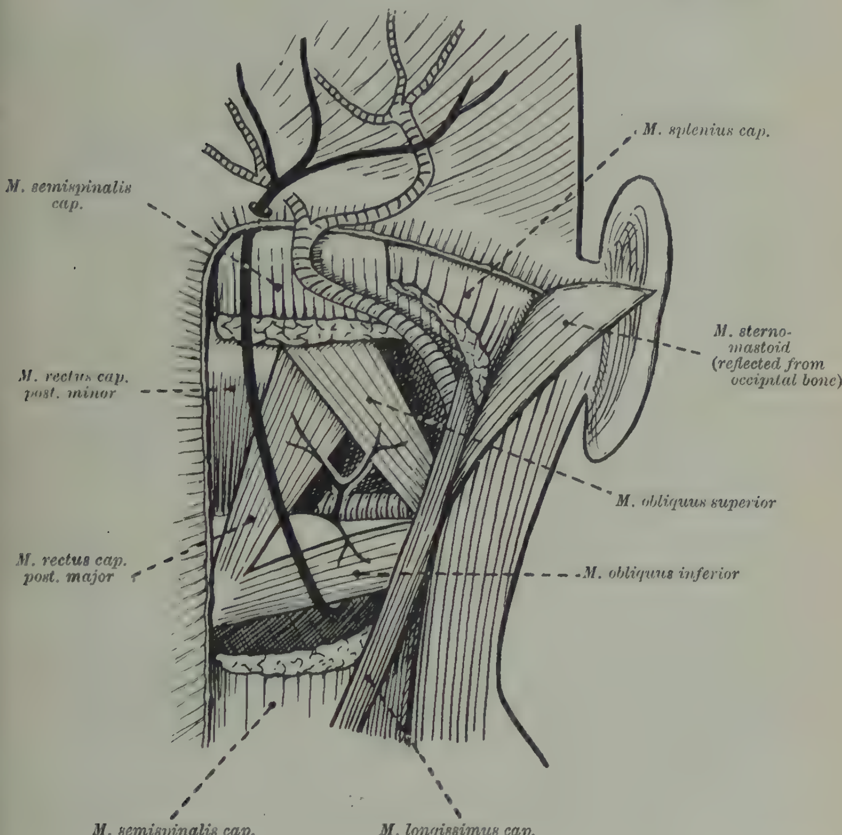


FIG. 16.

*Dissection of the suboccipital triangle.* The trapezius muscle has been completely removed. In the triangle the vertebral artery, the suboccipital nerve, the posterior arch of the atlas, and the posterior atlanto-occipital membrane are shown. The course and relations of the great occipital nerve and the occipital artery should be carefully followed.

**atlanto-occipital membrane**; and in the vertebral groove of the atlas the **vertebral artery** should be found and cleaned as far as the limits of the space permit.

The first cervical spinal nerve leaves the vertebral canal between the occipital bone and the atlas, and on this account is usually named the

**suboccipital nerve.** Its posterior division, which is being dissected at present, is larger than its anterior division, and does not, like the majority of the posterior divisions, divide into medial and lateral branches; nor as a rule does it give off any cutaneous branches. It enters the suboccipital triangle by crossing the posterior arch of the atlas below the vertebral artery, and divides into branches which supply the four muscles bounding the triangle and the semispinalis capitis. It also gives off a communicating branch which joins the great occipital nerve.

The **vertebral artery** issues from the foramen in the transverse process of the atlas, and crosses the floor of the suboccipital triangle in its passage into the interior of the skull (Fig. 16). It first curves backwards behind the upper articular process of the atlas, and then lies in the groove on the upper surface of its posterior arch; here the posterior division of the first cervical (suboccipital) nerve emerges from between the vessel and the bone. The artery leaves the triangle by passing beneath the lateral part of the posterior atlanto-occipital membrane. While in the suboccipital triangle it gives off a number of small branches to the surrounding parts.

The student should now make a general survey of the distribution of the **posterior divisions** of the **spinal nerves.** With four exceptions, namely, the first cervical, the fourth and fifth sacral, and the coccygeal nerves, each posterior division divides into a medial and a lateral branch; and these are expended in supplying the proper muscles and the skin of the back. The details of their arrangement differ in the different regions of the back.

**Cervical Nerves.**—The posterior division of the first cervical (suboccipital) nerve is distributed within the suboccipital triangle. It does not divide into medial and lateral branches as the posterior divisions of the remaining cervical nerves do. The **lateral** branches of the remaining nerves are of small size and end in those parts of the posterior spinal muscles which lie in the cervical region. The **medial** branches of the second, third, fourth, and fifth nerves run medially between the semispinalis cervicis and the semispinalis capitis giving twigs to both muscles in their course; and close to the middle line they pierce the latter muscle and become cutaneous, the branch of the second nerve being the great occipital, and that of the third the third occipital nerve. The occipital nerves ascend to the posterior part of the scalp, the others run more or less transversely across the neck (Fig. 9). The **medial** branches of the lower three cervical nerves run medially deep to the semispinalis cervicis; as a rule they do not give off cutaneous branches, being entirely expended in the spinal muscles.

**Thoracic Nerves.**—The **medial** branches of the posterior divisions of the upper six thoracic nerves run between the semispinalis dorsi and the multifidus muscle, both of which they supply; they then pierce the splenius, rhomboids, and trapezius muscles and become cutaneous close to the spinous processes. The medial branches of the lower six nerves are distributed to the multifidus and longissimus dorsi muscles. The **lateral** branches increase in size from above downwards. They proceed laterally beneath the longissimus dorsi to the interval between it and the ilio-costalis and supply these muscles; the lower five or six also give off cutaneous branches which pierce the serratus posterior inferior and the latissimus dorsi in a line with the angles of the ribs. The cutaneous

branches of the thoracic nerves have been dissected by the dissectors of the upper limb (see Vol. I., p. 7).

**Lumbar Nerves.**—The **medial** branches of the posterior divisions of the five lumbar nerves are small, and are distributed entirely to the multifidus muscle. The **lateral** branches supply the erector spinæ muscle. The upper three are of large size and give off cutaneous branches which pierce the aponeurosis of the latissimus dorsi at the lateral margin of the erector spinæ mass and descend across the posterior part of the iliac crest to the skin of the gluteal region. They have been examined by the dissectors of the lower limb (see Vol. I., p. 88).

**Sacral Nerves.**—The posterior divisions of the sacral nerves are small. The upper four emerge through the posterior sacral foramina, and the fifth at the lower end of the sacral canal. The upper three lie under cover of the multifidus muscle and divide into medial and lateral branches. The **medial** branches are very fine and end in the multifidus. The **lateral** branches are larger and join with one another to form loops on the dorsal surface of the sacrum. A second series of loops is formed from the first on the surface of the sacro-tuberous ligament under the gluteus maximus muscle, and from these two or three cutaneous branches are given off; they pierce the gluteus maximus and supply the skin over the posterior part of the buttock. The posterior divisions of the lower two sacral nerves do not divide into medial and lateral branches. They are very small, and, having united with each other and with the posterior division of the coccygeal nerve, they distribute small filaments to the skin over the coccyx.

**Coccygeal Nerve.**—The posterior division of the coccygeal nerve does not divide into a medial and a lateral branch, but after communicating with the last sacral nerve is distributed to the skin over the coccyx.

The **arteries** of the back, apart from the descending and deep cervical arteries, are of small size, and for the most part follow the trunks of the nerves. In the cervical region they are derived from the vertebral artery; in the thoracic region they are the posterior branches of the aortic intercostal arteries; and in the lumbar region similar branches arise from the lumbar arteries. These small arteries constitute the blood supply of the muscles and integuments of the back. They are accompanied by **veins** of much larger size, which anastomose to form a plexus, to be seen best in the neck, deep to the multifidus muscle and on the surface of the vertebral arches. It is named the **posterior external vertebral plexus.** It communicates with the veins of the vertebral canal, and drains into the vertebral, intercostal, and lumbar veins.

## THE SPINAL CORD

The examination of the **spinal cord** requires that the vertebral canal should be opened from behind. The first step in this dissection, and one which must be thoroughly carried out, is to clean the spinous processes and the vertebral laminæ on both sides

of all the muscle fibres attached to them. The vertebral arches must be cleanly exposed. The multifidus muscle must be completely removed from the back of the sacrum, and it is advisable to define the lower opening of the sacral canal. While removing the muscles some of the posterior divisions of the spinal nerves should be retained. The vertebral laminæ must now be sawn through on either side from the fourth cervical vertebra to the lower opening of the sacral canal, the following directions being strictly attended to:—The laminæ should be cut close to the medial side of the articular processes; the saw must be held so that it slants medially; the head should hang over the table to stretch the cervical region, and blocks should be placed under the body, as they are required, to flex the other regions; the greatest difficulty will be met in the lumbar region, and here it is usually easier to use the mallet and chisel rather than the saw; and on the sacrum care requires to be taken to open only the vertebral canal and not to saw through the whole thickness of the bone. The laminæ and spinous processes, connected together by the **ligamenta flava** and the **supraspinous** and **interspinous ligaments**, are to be removed in one piece. The ligaments should be examined at the present time while they are still soft.

The **supraspinous ligaments** are stout fibrous bands which connect together the apices of the spinous processes from the seventh cervical vertebra to the sacrum. They are thicker in the lumbar than in the thoracic region. In the neck they are replaced by the ligamentum nuchæ.

The **ligamentum nuchæ** is a band of white fibrous tissue which extends from the spinous process of the seventh cervical vertebra to the external occipital protuberance and crest, and is connected with the spines of the intervening vertebræ. It is to be considered as an upward continuation of the supraspinous ligaments of the thoracic region. It lies between, and gives origin to, the muscles of each side of the neck. In some of the quadruped animals it is of greater development and is composed of yellow elastic tissue, and then helps to sustain the weight of the head.

The **interspinous ligaments** are thin and membranous and connect together the adjoining spinous processes, their attachments extending from the root of the apex of each process. They are best developed in the lumbar region; in the neck they are weak.

The **ligamenta flava** (Fig. 17) connect the laminæ of adjacent vertebræ and are best seen from the side which faces the interior of the vertebral canal, of which, with the laminæ, they form the posterior wall. They are attached above and below along the whole length of the laminæ, so that the posterior borders of opposite ligaments come into contact in the middle line; the slit-like interval which is left between them gives passage to small veins. The ligaments are composed of yellow elastic tissue, the fibres of which run almost vertically between their attachments. Their elasticity, which can be tested by stretching the specimen, makes them a valuable aid to the muscles in restoring the vertebral column to the upright position after it has been bent forwards.

In the vertebral canal the **dura mater** of the spinal cord is exposed, but between it and the walls of the canal the dissector will note, most abundant in the sacral region, a quantity of loose areolo-fatty tissue. This tissue contains a series of **venous plexuses** and a large number of small **spinal arteries**. They cannot be examined in any detail, but the dissector should understand their general arrangement.

The **vertebral venous plexuses**, two in number, anterior and posterior,

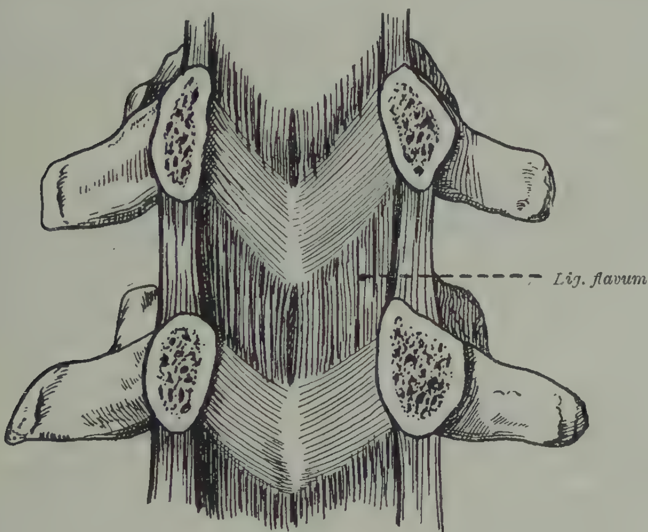


Fig. 17.

*The ligamenta flava (as seen from the vertebral canal).*

extend the whole length of the vertebral canal. They are placed in the interval between the dura mater and the bone, and anastomose freely with each other. The posterior plexus communicates with the posterior external venous plexus by wide channels which either pierce the ligamenta flava or issue through the intervertebral foramina ; and through these vessels it is connected with the vertebral, intercostal, and lumbar veins. The anterior plexus, which cannot be seen at present, receives large tributaries from the bodies of the vertebræ. Branches arise from it and run backwards to the intervertebral foramina and there join the emerging branches of the posterior plexuses.

The **spinal arteries** are a series of small vessels which enter the vertebral canal through the intervertebral foramina. In the cervical region they are derived from the vertebral artery, in the thoracic region from the posterior branches of the intercostal arteries, in the lumbar region from the lumbar arteries, while in the sacral region they are

branches of the lateral sacral arteries. These vessels supply the bony walls of the vertebral canal and its ligaments, the membranes of the spinal cord, and the cord itself. The branches to the spinal cord perforate the dura mater with the corresponding spinal nerves. It is not likely, however, that the dissector will be able to find more than the main trunks.

The **dura mater** should now be examined. It is the most external of the three **meninges** which envelop the spinal cord, the innermost being the pia mater, and the intermediate membrane the arachnoid. These membranes are, of course, directly continuous with the corresponding membranes of the brain. The dura mater requires little cleaning, but three or four of the prolongations which are carried from it over the spinal nerves into the intervertebral foramina should be exposed by removing the necessary bone with the bone forceps.

The **dura mater** forms a loose sheath round the spinal cord from the foramen magnum above to the level of the second or third piece of the sacrum below. It consists of dense fibrous tissue, sparingly supplied with blood vessels, and is rough externally but smooth and shining on its internal surface as will be seen when it is opened. It is attached above round the circumference of the foramen magnum and to the second and third cervical vertebræ, while in the lumbar region fibrous slips connect it to the posterior longitudinal ligament of the vertebral column. In the sacral canal it narrows rapidly and ends opposite the second or third vertebra by blending with the filum terminale which descends to the back of the coccyx. The dura mater is prolonged over the roots of the spinal nerves in the form of tubular sheaths which are carried into the intervertebral foramina and are attached there (Fig. 18). These prolongations are short in the upper part of the vertebral canal but become much longer below. Apart from the attachments described the dura mater is separated from the wall of the vertebral canal by a space which contains loose areolo-fatty tissue and the vertebral venous plexuses.

A small median incision is to be made in the dura mater with a knife, care being taken not to perforate the subjacent thin and transparent **arachnoid**. The whole length of the dura should then be slit open with scissors, and the **subdural space** thus opened. The deep surface of the dura will be seen to be smooth and shining, and it is to be noted that, as seen from this surface, the two roots of each spinal nerve perforate it separately. The tubular sheath of dura mater previously exposed is therefore double, and its two parts may be demonstrated by removing the fibrous tissue which binds them together. They will then be seen to remain separate as far as the ganglion on the posterior root. The **arachnoid** and the **pia mater** are then to be examined.

It is improbable that the **arachnoid** will have been retained intact, but sufficient of it will remain to show that it forms a loose tubular

sheath for the cord. It is an extremely delicate and transparent membrane. It is continuous above with the arachnoid of the brain, and is carried laterally over the nerve roots forming for each a tubular sheath ; and it ends blindly at the level of the second or third piece of the sacrum. The interval between the arachnoid and the pia mater is the **subarachnoid space** (Fig. 18). This space is widest below where it envelops the end of the spinal cord and the nerves which proceed from it ; above it is continuous with the cranial subarachnoid space. It is partially subdivided by three incomplete septa. One of these, the subarachnoid septum, connects the arachnoid with the pia mater covering the posterior surface of the cord ; it is cribriform above but more complete below. The other septa are the **ligamenta denticulata** which spread out from each side of the cord (Fig. 18).

The **pia mater** is a tough vascular membrane. It is firmly adherent to the surface of the spinal cord and is continued into its anterior fissure. Below the end of the cord it is prolonged on the filum terminale, a long

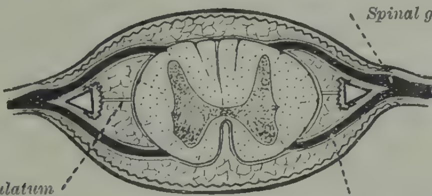


FIG. 18.

*A diagrammatic transverse section of the cord and its membranes.* The dura mater is the heavy outer line, the arachnoid is waved, while the pia mater closely invests the cord. Note how each root of the spinal nerve carries a separate covering of the membranes.

slender filament which descends through the centre of the mass of the lower spinal nerves, and having pierced the dura mater, is prolonged to the coccyx. The pia mater of the cord is denser than the pia mater of the brain owing to the addition of an outer fibrous layer. It is thickened along the middle line of the anterior surface of the cord to form a longitudinal fibrous band, the linea splendens, and the ligamentum denticulatum is a somewhat similar band situated on either side.

The **ligamentum denticulatum** is a narrow fibrous band on either side of the spinal cord and extends along its whole length. Its medial border is attached to the pia mater in a continuous line between the anterior and posterior nerve roots, but the lateral margin is widely serrated and forms a series of tooth like processes which are attached to the dura mater. There are usually twenty-one of these processes, the first of which is attached to the dura mater opposite the foramen magnum between the vertebral artery and the hypoglossal nerve. The others are placed in the intervals between successive spinal nerves.

The general anatomy of the **spinal cord** is to be studied while it still lies in the vertebral canal. It is a cylindrical structure, slightly flattened in front and behind, and very much smaller than the canal which contains it. It extends from the level of the

foramen magnum, where it is continuous with the medulla oblongata of the brain, to the lower border of the first or the upper border of the second lumbar vertebra. Its lower end tapers rapidly, and is named the **conus medullaris**, and from the apex of this a slender filament, the **filum terminale**, is prolonged to the dorsal surface of the coccyx. The greater part of the thoracic portion of the cord is almost uniformly circular on transverse section, but above and below it shows marked swellings named, respectively, the **cervical** and **lumbar enlargements**. The cervical swelling is the more pronounced. It extends from about the third cervical to the second thoracic vertebra, and corresponds with the attachments of the nerves of the upper limbs. The lumbar enlargement has attached to it the nerves of the lower limbs. It begins at the level of the ninth thoracic vertebra, and reaches its maximum size opposite the last thoracic vertebra; below this the cord tapers rapidly into the conus medullaris.

The **filum terminale** is a glistening, thread-like filament which is prolonged downwards from the apex of the conus medullaris. Its upper part is contained within the sheath of the dura mater and arachnoid and is surrounded by the lower spinal nerves. At the level of the second or third piece of the sacrum it pierces the end of the dura and receives a covering from it; and then extends downwards to the back of the first piece of the coccyx where it ends by blending with the periosteum. The filum terminale consists mainly of fibrous tissue which is continuous above with the pia mater. The central canal of the spinal cord, however, is prolonged into it for about two inches, and a few nervous elements can be detected on its surface for a like distance.

There are thirty-one pairs of **spinal nerves** attached to the spinal cord. These are grouped in five sets, cervical, thoracic, lumbar, sacral, and coccygeal, according to the vertebræ with which they are associated. There are eight **cervical** nerves, the first of which leaves the vertebral canal between the occipital bone and the atlas, while the eighth emerges below the seventh cervical vertebra; there are twelve **thoracic**, five **lumbar**, and five **sacral** nerves, each of which leaves the vertebral canal below the vertebra with which it corresponds in number; and there is one **coccygeal** nerve.

A part of the thoracic region of the spinal cord, about two or three inches in length, is to be removed from the vertebral canal with the membranes covering it, the spinal nerves attached to it being divided in the intervertebral foramina. The dura mater of the specimen should be slit along the middle line in front and the arachnoid cleared away. The mode of formation of the spinal

nerves can then be studied (Fig. 19). Each spinal nerve springs from the cord by two **roots**, an **anterior** or ventral root composed of outgoing or motor fibres, and a **posterior** or dorsal root formed of ingoing or sensory fibres. Each of these roots consists of several (five to eight) bundles of nerve fibres which spread out from each other as they approach the cord. The posterior rootlets or fila, as the bundles are named, are attached to the spinal cord

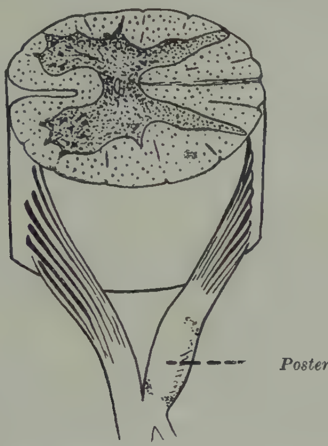


FIG. 19.

*Diagram to show the formation of the spinal nerves.* Note that the fila of the posterior root are attached to the cord in a straight line, but that the anterior fila are attached irregularly. The student should label the anterior and posterior roots and the spinal nerve trunk.

along a continuous straight line and at the bottom of a slight groove; the anterior rootlets, on the other hand, are not regularly placed but emerge from the cord irregularly over an area of some width. The two roots pierce the dura mater separately, and it will be noted that the posterior root is the larger; in the first cervical nerve only is it the smaller, sometimes indeed it is absent. The dura mater sheath being cut away, the posterior root will be seen to be distinguished by the presence of an oval swelling, the **spinal ganglion** (posterior root ganglion), and immediately beyond the ganglion the two roots unite to form the **spinal nerve trunk.**

The spinal cord being so much shorter than the vertebral

canal, the lower nerve roots have to descend a considerable distance within the dura mater before they reach the intervertebral foramina through which they pass. It will be noted, therefore, that while in the upper cervical region the nerve roots are short and run almost transversely to their respective foramina, below this they become more and more oblique in direction; and that the lumbar and sacral nerves are exceedingly long and descend almost vertically. The appearance these lower nerve roots presents is very characteristic, and the mass they form round the conus medullaris and the filum terminale is appropriately named the **cauda equina**.

The dura mater sheaths of the nerve roots, which have already been exposed in the intervertebral foramina, should now be removed to show the position of the spinal ganglia, and just beyond the ganglia the union of the two nerve roots to form the spinal nerve trunks. The ganglia are placed in the intervertebral foramina, except those of the sacral nerves which lie in the sacral canal though outside the tube of dura mater. The spinal nerve trunks, apart from those of the sacral nerves, are very short; indeed, almost immediately after their formation they divide into **anterior** and **posterior divisions** (Fig. 19).

The spinal cord and its membranes are now to be cut across at the upper limit of the dissection, and by pulling on the dura mater and cutting the spinal nerves in the intervertebral foramina as they are reached, the upper part of the cord is to be lifted from the vertebral canal. The lower part should be removed in the same way. The dura mater should then be slit down the middle line in front and the specimen examined under water. In this way the arachnoid, the ligamenta denticulata, and the nerve roots can be studied with great advantage; and an examination may be made of the **arteries** of the **spinal cord** if they have been well injected.

The **arteries** of the **spinal cord** are arranged as three longitudinal trunks on its surface. One of these, the **anterior spinal** artery, lies in the middle line in front under cover of the linea splendens. It is formed above by the union of the two anterior spinal branches of the vertebral arteries which arise within the cranium, and the single trunk they form descends on the front of the cord (Fig. 74). The other longitudinal trunks, the **posterior spinal** arteries, lie in front of the posterior nerve roots on each side of the cord, and branches from them form a free anastomoses round the roots. They commence above within the cranium as the posterior spinal branches of the vertebral arteries (p. 216). As the three spinal arteries descend on the cord, they are reinforced by a succession of small lateral branches which enter the vertebral canal through the intervertebral foramina (p. 47). These branches are derived in series from the vertebral, intercostal, and lumbar arteries, and by

their means the longitudinal stems are continued to the lower end of the cord.

The **veins** of the **spinal cord** are small, and form a tortuous plexus on its surface. In this plexus there are two median longitudinal trunks, one in front and one behind, and four lateral trunks in relation, respectively, to the anterior and posterior nerve roots. The spinal plexus communicates with the internal vertebral plexus by small twigs which run laterally on the nerve roots.

If the spinal cord is at all well preserved, a good deal can be learned of its **internal structure** if transverse sections be made across it at different levels and these be examined with a hand lens. It is an interesting experiment, and facilitates their study, if some of the sections be immersed in ordinary ink for about three minutes and then washed well in water.

The sections from the thoracic region of the cord are almost circular, while those from the cervical and lumbar enlargements are not only larger but also more oval. On them all (Fig. 20) there can be seen the **anterior fissure** and the **posterior septum**, both lying in the median plane; the former contains a fold of pia mater and the anterior spinal artery. They partially divide the cord into right and left halves, but these are connected across the middle line by white and grey commissures which intervene between the fissure and the septum. It will also be noted that along the line of entrance of the posterior nerve roots there is a definite groove, the **postero-lateral sulcus**; but there is no similar groove opposite the attachment of the anterior roots since they emerge from the cord over the whole width of the underlying anterior horn of grey matter.

An inspection of the surface of each transverse section shows that the spinal cord is composed of a central core of **grey matter** and a peripheral coating of **white matter** which surrounds the grey matter on all sides (Fig. 20).

The **grey matter** is in the form of the letter H, a comma-shaped mass, concave laterally, lying in each half of the cord and being connected to that of the opposite side by a narrow transverse band named the **grey commissure**. In the grey commissure, just visible to the naked eye, there may be seen the **central canal** of the cord. This canal runs the entire length of the cord and is continued into the upper part of the filum terminale; above it opens into the fourth ventricle of the brain. Each lateral crescentic mass of grey matter consists of an **anterior** and a **posterior horn** (or column). The anterior horn is short, thick, and rounded, and is separated from the surface of the cord by an intervening layer of white

matter; the posterior horn, on the other hand, is narrow and pointed, and almost reaches the surface of the cord opposite the attachments of the posterior nerve roots.

The **grey matter** is not present in equal amount in all parts of the cord, being much increased opposite the attachments of the great nerves which form the limb plexuses, that is, in the cervical and lumbar enlargements. The shape of the grey matter also differs in different regions of the cord, so that a section taken from each region could be readily recognised.

The **white matter** covers the grey matter, and in each half of

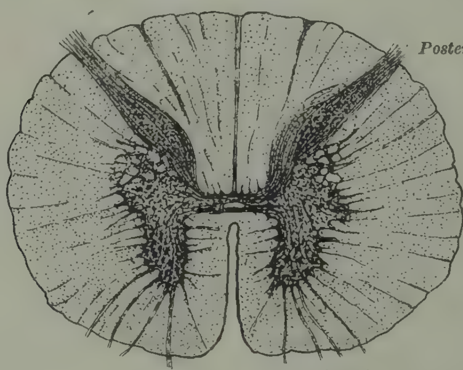


FIG. 20.

*Transverse section of the spinal cord.* The student should name the anterior fissure and the posterior septum, the different parts of the grey matter, the central canal of the cord, and the columns of the white matter.

the cord is marked off by it into three columns or funiculi (Fig. 20). The posterior funiculus is wedge shaped on transverse section and lies between the posterior horn of grey matter and the posterior septum. In the cervical region indications may be seen of a septum dividing it into two parts, the tractus gracilis and the tractus cuneatus. The lateral funiculus lies opposite the grey matter, being bounded behind by the posterior horn of grey matter, and extending in front to the anterior nerve roots. The anterior funiculus comprises the white matter between the anterior fissure and the anterior horn of grey matter, and also the white matter which separates the anterior horn from the surface of the cord. The two anterior columns are connected together across the middle line by the **white commissure**, which lies between the grey commissure and the bottom of the anterior fissure.

## THE ANTERIOR PART OF THE NECK

(The body will now be turned on its back with the thorax and the pelvis supported by blocks. The head is to be allowed to hang over the end of the table so that the dissector may examine the region of the front of the neck.)

**Surface Anatomy.**—The **front** of the **neck** is considered to **extend**, on each side, as far as the anterior border of the sterno-mastoid **muscle**; it is, therefore, of considerable breadth above where it is limited by the lower margin of the jaw, but is quite narrow below where it is bounded by the upper border of the manubrium sterni. The **hyoid bone**, which in the normal position of the head is only slightly below the level of the chin, should be palpated in the middle line, and if the fingers be carried along it the ends of its **greater cornua** will be found to lie immediately in front of the sterno-mastoid muscles. Above the hyoid bone is the region of the **floor** of the **mouth**. The anterior angular border (pomum Adami) and the upper margin of the **thyreoid cartilage** are easily distinguished. The interval between the hyoid bone and the thyreoid cartilage, the **thyreo-hyoid space**, is to be carefully palpated, and the student should study on his own neck the differences in its size when the head is flexed and extended and during the process of swallowing. It is filled by the **thyreo-hyoid membrane**. Below the thyreoid cartilage the rounded anterior part of the **cricoid cartilage** can be felt, and below it again the rings of the **trachea**. The trachea gradually recedes from the surface as it descends, but crossing its upper part the dissector may be able to define the isthmus of the **thyreoid gland**; it is much more easily detected, however, in the living subject.

An incision is to be made in the skin in the middle line of the neck from the chin to the sternum, and from its lower end another is to be carried along the clavicle to the acromion process. The flap thus marked out is to be reflected backwards so that, with the parts of the skin already removed from the back, the whole surface of the neck becomes uncovered.

The **superficial fascia** of the neck is exposed. It is thin except under the jaw where it contains fat, often in some quantity. In it there lie the fibres of the **platysma myoides** muscle. This is a broad thin sheet of muscle which commences below over the clavicle and runs upwards and anteriorly the whole length of the neck and over the lower jaw on to the face, where it has already been dissected with the facial muscles.

The **platysma myoides** is a broad sheet of pale fibres which arise in the fascia covering the upper parts of the pectoralis major and deltoid muscles. They proceed obliquely upwards and forwards across the clavicle and along the side of the neck towards the lower jaw. The posterior fibres cross the mandible and are inserted with the other facial muscles about the angle of the mouth and the lower part of the face (Fig. 5). The anterior fibres are inserted into the lower border of the jaw close to the middle line, the most anterior fibres decussating with those of the opposite side.

The platysma muscle should now be carefully reflected from below upwards as an entire sheet, and while doing so the dissector must secure the following structures which lie beneath it (Fig. 21): (1) The **supraclavicular nerves**, branches of the cervical plexus, which pierce it a short distance above the clavicle and descend to the upper parts of the chest. (2) The **external jugular vein.** (3) The **transverse cervical nerve**, a branch of the cervical plexus, which crosses the middle of the sterno-mastoid muscle and passes either superficial or deep to the external jugular vein. When followed forwards it divides into ascending and descending branches which pierce the platysma muscle and are distributed to the skin on the front of the neck. (4) The **cervical branch** of the **facial nerve** which runs forwards from below the angle of the jaw. It communicates with the upper branch of the transverse cervical nerve and supplies the platysma muscle.

## SUBCLAVIAN TRIANGLE

These structures having been secured, the student must turn to complete the dissection of the **subclavian** part of the **posterior triangle** of the neck.

He should identify again the **branches of the cervical plexus** which he dissected before (p. 72), namely, the **small occipital** and **great auricular** nerves which run upwards, the **transverse cervical** nerve which crosses transversely to the front of the neck, and the **supraclavicular** nerves which run downwards over the clavicle.

The **supraclavicular nerves** (Fig. 21) arise from the third and fourth cervical nerves. They appear at the posterior border of the sterno-mastoid muscle and descend in the posterior triangle of the neck under the deep fascia and the platysma muscle. Near the clavicle they perforate these coverings and become cutaneous, and can be arranged in three groups according to their position. The anterior branches cross the external jugular vein and pass towards the middle line over the sterno mastoid muscle. The middle nerves cross the clavicle to reach the upper part of the chest, while the posterior branches pass obliquely laterally on to the trapezius and deltoid muscles and supply the skin of the shoulder. That these nerves pass from the neck to supply the skin

of the upper part of the trunk is to be related with the absence of cutaneous branches from the first intercostal nerve.

The **deep fascia** over the subclavian triangle should then be examined. It consists of two layers, a superficial and a deep. The superficial layer, which will have been removed in great part, is attached to the upper border of the clavicle between the sterno-mastoid and trapezius muscles, while the deep layer is attached to the posterior surface of the clavicle. The space between the two layers is occupied by areolar tissue and contains part of the **external jugular vein**; and joining this vein there are to be secured the terminal parts of the **transverse cervical, suprascapular,** and **anterior jugular veins** (Fig. 21).

The **external jugular vein** (Fig. 21) receives the greater part of the blood from the exterior of the cranium and the deeper parts of the face; but it varies a good deal in its size. It can often be seen through the skin in the living subject. It commences at the lower margin of the parotid gland by the union of the posterior auricular vein and the posterior division of the posterior facial vein (Fig. 22), and runs vertically down the neck in the superficial fascia under the platysma muscle. The transverse cervical nerve passes forwards either superficial or deep to it. In its course it crosses the sterno-mastoid muscle, at the posterior border of which it enters the subclavian triangle and there pierces first the superficial layer and then the deep layer of the deep fascia. It then crosses the brachial plexus, the posterior belly of the omo-hyoid muscle and the subclavian artery, and ends in the subclavian vein. Its tributaries are the transverse cervical, suprascapular, and anterior jugular veins, and there often joins it at the posterior border of the sterno-mastoid muscle, the **posterior external jugular vein,** which descends over the posterior triangle from the occipital region.

The deeper layer of the deep fascia is continuous above with the fascia round the **posterior belly** of the **omo-hyoid** muscle; it is to be carefully removed and the muscle defined.

The **posterior belly** of the **omo-hyoid** muscle (Fig. 21) arises from the suprascapular ligament and the neighbouring part of the upper border of the scapula (see p. 66). It enters the posterior triangle of the neck at its lower and posterior angle and runs upwards and forwards, at only a short distance above the clavicle, to the posterior border of the sterno-mastoid muscle under which it passes. It divides the posterior triangle into occipital and subclavian parts. There have already been secured, deep to it, the upper part of the brachial plexus and the transverse cervical artery.

The boundaries of the subclavian triangle are now clearly defined; namely, the omo-hyoid muscle above, the sterno-mastoid muscle in front, and the clavicle below (Fig. 12). The clavicle should be depressed as far as possible by dragging on the arm,

and in the triangle the following structures should be dissected (Fig. 21):—

1. The **suprascapular** (transverse scapular) **artery**, which will be found running transversely behind the clavicle; strictly speaking, therefore, it is outside the triangle.

2. The upper part of the **brachial plexus**, which emerges at the lateral border of the **scalenus anterior** muscle and runs down-

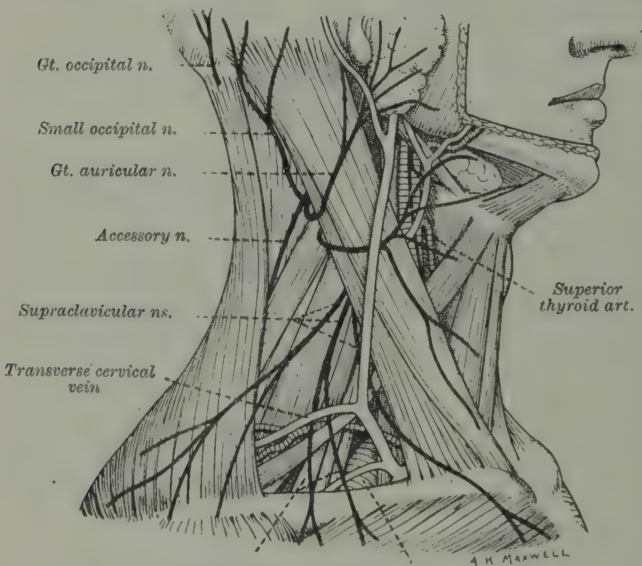


FIG. 21.

*Superficial dissection of the side of the neck.*

wards and laterally towards the axilla. This part of the plexus lies partly in the occipital and partly in the subclavian triangle, being crossed by the omo-hyoid muscle. No detailed study need be made of it at this stage of the dissection.

3. The **subclavian artery**, only a small portion of which lies in the triangle, and the **subclavian vein** which lies below the artery and as a rule outside the triangle. The artery is deeply situated, but the student will readily find it by dissecting below the brachial plexus. It rests behind on the first rib, against which it can be compressed; and anterior to it there are the following structures: the skin, the superficial fascia with the supraclavicular

nerves and the platysma muscle, the deep fascia which is arranged in two layers, the terminal part of the external jugular vein, the suprascapular artery, and the small **nerve** to the **subclavius muscle** which may not be found at the present time.

The part of the **subclavian artery** (Fig. 21) which is exposed in the subclavian triangle is the third or terminal portion, and of the three parts into which this vessel is divided (p. 76) it is the most superficial. It emerges from below the lateral border of the scalenus anterior muscle and extends to the outer border of the first rib where it becomes the axillary artery. The structures which lie in front of it have already been mentioned. It should be noted that at its highest point the vessel only reaches about half an inch above the upper border of the clavicle, but in this respect there is considerable variation. The subclavian vein lies at a slightly lower level and in front of the artery. Above and to its lateral side are the upper trunks of the brachial plexus and the omo-hyoid muscle; the lowest trunk of the plexus lies behind the artery and intervenes between it and the scalenus medius muscle.

## THE ANTERIOR TRIANGLE

The **anterior triangle** of the side of the neck should now be defined. It is bounded behind by the anterior border of the sterno-mastoid muscle, above by the lower border of the jaw, and in front by the middle line of the neck (Fig. 12). In the superficial fascia which covers it, the **anterior jugular vein** should be secured close to the middle line and followed upwards to the submental region, and downwards to the point at which it pierces the deep fascia.

The **anterior jugular vein** begins near the hyoid bone by the confluence of several small superficial veins from the submental region. It descends in the superficial fascia close to the middle line, and at the lower part of the neck pierces the deep fascia. It then passes laterally beneath the sterno-mastoid muscle and ends in the external jugular vein (p. 57) or sometimes in the subclavian vein. Just above the sternum the two veins are connected to one another by a transverse trunk. The anterior jugular vein varies considerably in its size; when it is large it receives the whole or part of the common facial vein. Sometimes it is absent on one side of the neck.

The superficial fascia is now to be cleared from the triangle so that the **deep fascia** may be examined. This forms a continuous layer from the sterno-mastoid muscle of one side to that of the other and from the lower jaw to the sternum; it is firmly attached, however, to the body and great cornua of the hyoid bone. Above the hyoid bone it consists of two layers, the superficial of which is attached along the lower border of the mandible; behind the angle of the jaw, however, it extends upwards over the parotid

gland and is attached to the zygomatic arch. This layer should be removed by dividing it at its mandibular attachment, the **facial artery** and the **anterior facial vein** which pierce it being preserved. The **submaxillary salivary gland** will be exposed. On the surface of this gland and in the interval between it and the jaw the **submaxillary lymph glands** should be sought, and then the anterior facial vein should be traced across its posterior part ; and behind the gland, and usually overlapped by it, there are to be defined two slender muscles close together, the **stylo-hyoid** above and the **posterior belly** of the **digastric** muscle below (Fig. 23). If the submaxillary gland be raised the deeper layer of the fascia will be seen, and if the handle of a knife be placed on it and pushed gently upwards it will pass as far as the attachment of the fascia to the mylo-hyoid ridge on the deep surface of the mandible. The submaxillary gland, therefore, is enclosed in a sheath formed by two layers of the upper part of the deep cervical fascia. The lower part of the cervical fascia also consists of two layers. The superficial of these is attached below to the front of the sternum and is carried over the sterno-mastoid muscles at the sides. It should be removed by incising it along the anterior borders of the sterno-mastoid muscles, care being taken to preserve the anterior jugular veins which pierce it. The space which is thus opened into is named the **suprasternal space** (of Burns), and in it the lower parts of the anterior jugular veins and the transverse anastomosis between them will be found. The deeper layer of the fascia, which forms the floor of the space, is attached at the root of the neck to the posterior surface of the manubrium sterni, while at the sides it passes deep to the sterno-mastoid muscles. When followed upwards it fuses with the superficial layer about midway between the sternum and the thyreoid cartilage.

The deep fascia should now be removed from the anterior triangle to expose its contents. Below the hyoid bone there are to be defined and cleaned, without disturbing them in position, three slender band-like muscles which run more or less perpendicularly (Fig. 21). The lateral muscle is the **anterior belly** of the **omo-hyoid**, and that medial to it and on the same plane is the **sterno-hyoid** ; the third muscle, the **sterno-thyreoid**, lies deep to the sterno-hyoid, but at its lower part is a little nearer the middle line and can then be seen from the surface. Beneath the upper part of the sterno-hyoid a small quadrilateral muscle, the **thyreo-hyoid**, should be recognised ; it extends between the thyreoid cartilage and the hyoid bone. In the middle line of the neck, and

between the muscles of the two sides, the following structures are to be exposed from above downwards :—

(1) The anterior part of the **thyreoid cartilage** forming the prominence of the pomum Adami at its upper end ; and above it, in the thyreo-hyoid interval, the **thyreo-hyoid membrane**. The membrane is covered with a little loose areolar tissue, but when

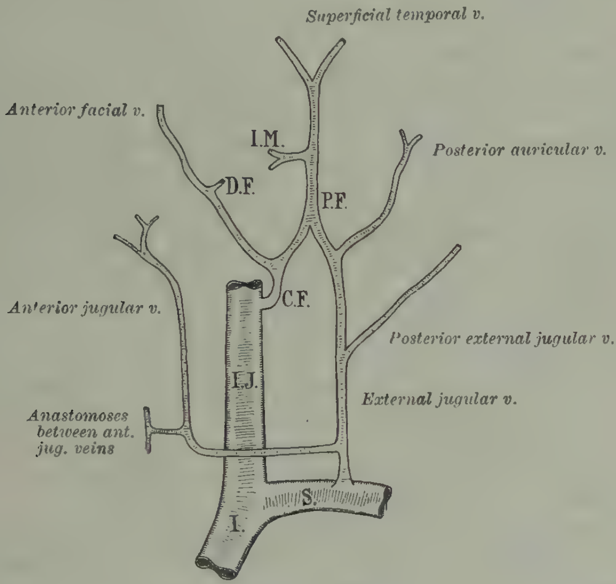


FIG. 22.

*A scheme of the veins of the face and neck.*

I.M. Internal maxillary.
D.F. Deep facial.
P.F. Posterior facial.
C.F. Common facial.
I.J. Internal jugular.
S. Subclavian.
I. Innominate.

this is cleared away, it will be seen to be attached below to the upper border of the thyreoid cartilage and to extend upwards deep to the body of the hyoid bone to be attached to its upper border.

(2) The rounded anterior arch of the **cricoid cartilage**, and between it and the thyreoid cartilage, the **crico-thyreoid ligament**. On the surface of the ligament, close to the thyreoid cartilage, a transverse anastomosis between the crico-thyreoid branches of the superior thyreoid arteries should be sought.

(3) The first ring of the **trachea**, united to the cricoid cartilage by the **crico-tracheal ligament**.

(4) The **isthmus**, a narrow median transverse part of the **thyreoid gland**. It is connected to the lower border of the thyreoid cartilage by a band of fascial tissue which prevents it from being displaced downwards. Occasionally a pyramidal process of the gland or a small slip of muscle (levator glandulæ thyreoideæ) extends upwards from the isthmus. The muscle, when it is present, is attached above to the lower border of the hyoid bone, while the pyramidal process may either end in a pointed extremity or be continued into a fibrous cord which passes deep to the hyoid bone; the cord is the remains of the thyreo-glossal duct.

(5) Below the isthmus of the thyreoid gland the **trachea** recedes from the surface. In the areolar tissue which overlies it there should be secured and cleaned the **inferior thyreoid veins** (Fig. 23). They pass downwards, communicating freely with one another, and disappear behind the sternum, where they join the innominate veins. Sometimes a small median artery, the **thyreoida ima**, will be found ascending between them to the isthmus of the thyreoid gland. The layer of fascia which covers the trachea is named the **pretracheal layer**. It envelops the thyreoid gland and is attached above to the thyreoid cartilage, while at the root of the neck it descends into the thorax and blends below with the fibrous pericardium.

The region above the hyoid bone is the floor of the mouth. In it there should be defined (Fig. 21):—

(1) The **anterior belly** of the **digastric** muscle, which is attached to the mandible close to the symphysis and descends towards the hyoid bone. Between the muscles of the two sides a few small **submental lymph glands** may be found; they receive the lymph from the anterior part of the tongue and the middle part of the lower lip.

(2) The anterior part of the **mylo-hyoid** muscle, on which the digastric lies. Its fibres run towards the middle line and are inserted into a median fibrous raphe.

The **anterior triangle** of the neck is subdivided into three subsidiary parts by the two bellies of the digastric muscle and the anterior belly of the omo-hyoid. These parts and their boundaries, which are now fully displayed, are as follow (Figs. 12 and 21):—

The **submaxillary triangle** is bounded below by the two bellies of the digastric muscle and above by the lower border of the mandible.

The **carotid triangle** is bounded behind by the anterior border of the sterno-mastoid, and in front by the posterior belly of the

digastric muscle above and the anterior belly of the omo-hyoid below.

The **muscular triangle** is limited in front by the middle line of the neck, and behind by the omo-hyoid muscle above and the sterno-mastoid below.

In addition to these triangles on each side of the neck there is a small area above the hyoid bone between the anterior bellies of the digastric muscles which is common to the two sides; it is named the **submental triangle**.

The more superficial contents of each of these triangles have now to be secured. All of them will be met with in later dissections, when they will be described; at present they are only to be found, recognised, and followed as far as the limits of each triangle permit (Figs. 21 and 23).

In the **submaxillary triangle**, the submaxillary salivary gland and the lymph glands related to it should be cleaned, and the anterior facial vein traced downwards as far as possible. The salivary gland should then be turned upwards and fixed. The **mylo-hyoid nerve** and **artery** are to be secured by finding first the branches of them which enter the posterior border of the anterior belly of the digastric muscle, and then the main trunks which lie on the mylo-hyoid muscle. The anterior and posterior bellies of the digastric muscle should be followed towards their intermediate tendon which lies above the great cornu of the hyoid bone; and it will be observed that this tendon is embraced by the cleft lower end of the **stylo-hyoid** muscle and is fixed to the hyoid bone by a strong fascial band. Behind the anterior belly of the digastric the posterior part of the **mylo-hyoid** muscle should be cleaned until its posterior free margin is defined; and there will then be seen, deep to it, part of the **hyoglossus** muscle. Passing under the posterior border of the mylo-hyoid muscle, close to the great cornu of the hyoid bone, there are to be found the **hypoglossal nerve** and immediately below it the **lingual vein** (Fig. 23); while deep to the hyoglossus muscle at the same level, and to be exposed for a short distance by cutting through its fibres, there is the **lingual artery**.

The **carotid triangle** should be next explored. The anterior facial vein should be followed across the posterior belly of the digastric muscle and its junction with the **posterior facial vein** (p. 61) below the lower end of the parotid gland should be defined. The trunk which is formed by the union of these vessels is the **common facial vein** (Fig. 22). This vein and the **lingual vein**

should be traced downwards and backwards to their union with the **internal jugular vein** at or under the anterior border of the sterno-mastoid muscle. At a lower level, opposite the thyreo-hyoid interval, the **superior thyreoid vein** or **veins** should be found; it joins the common facial vein or enters the internal jugular trunk directly (Fig. 23). The **hypoglossal nerve** should then be followed

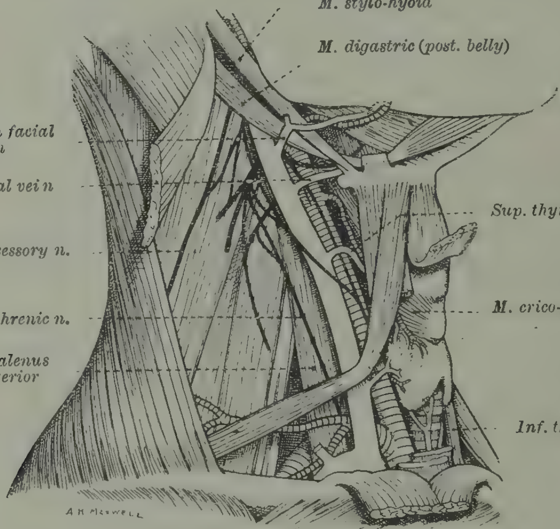


FIG. 23.

*Deep dissection of the side of the neck.* The sterno-mastoid and the sterno-hyoid and sterno-thyreoid muscles have been reflected. The following structures should be identified: the internal jugular vein and the carotid arteries; the subclavian, transverse cervical, and suprascapular arteries; and the cervical plexus, the communicans hypoglossi, the ansa and descendens hypoglossi, and the hypoglossal nerve.

backwards into the carotid triangle; it passes deep to the posterior belly of the digastric and the stylo-hyoid muscles (Fig. 23). It will then be found to cross the internal and external carotid arteries, and as it does so it gives off its descending branch, the **descendens hypoglossi**. This nerve should be traced downwards in the fascia which covers the arteries until it disappears under cover of the anterior belly of the omo-hyoid muscle. It is joined there, from the lateral side, by a communicating branch from the second and third cervical nerves, the **communicans hypoglossi** (Fig. 23), the loop which is formed by the junction of the two

nerves being named the **ansa hypoglossi**. The communicans hypoglossi may lie either superficial or deep to the internal jugular vein. In front of its descendens branch and opposite the tip of the great cornu of the hyoid bone, the hypoglossal nerve gives off its **branch** to the **thyreo-hyoid** muscle which should be secured and followed forwards to the muscle. The fascial sheath which surrounds the upper part of the **common carotid artery** should then be removed and the vessel carefully cleaned. It divides at the level of the upper border of the thyreoid cartilage into the **internal** and **external carotid arteries**; and it is to be noted that the external artery lies at first on the medial side and a little in front of the internal artery. The **internal** and **external laryngeal nerves** should be secured at this stage of the dissection. They are the terminal branches of the **superior laryngeal** branch of the **vagus** nerve (Fig. 37). The internal nerve will be found in the thyreo-hyoid interval behind the posterior border of the thyreo-hyoid muscle, under which it disappears; it is accompanied and covered by the **laryngeal** branch of the **superior thyreoid artery**. The external nerve is much smaller in size and more difficult to find; it should be sought in its course to the crico-thyreoid muscle deep to the superior thyreoid artery at the level of the thyreoid cartilage. The **internal jugular vein** is to be cleaned and it should be separated from the lateral side of the common carotid and internal carotid arteries. In the interval between the vein and the arteries, and deep to them, the **vagus nerve** will readily be found. The dissector must then proceed to clean and follow out the **branches** of the **external carotid artery**, and while this is being done he will have to remove the **deep cervical lymph glands** which lie on the surface of the great arteries and the internal jugular vein. There are five branches of the external carotid artery to be secured: (1) The **superior thyreoid** artery arises just below the level of the great cornu of the hyoid bone and runs downwards and disappears under the anterior belly of the omo-hyoid muscle to reach the thyreoid gland. It gives off a small infrahyoid branch and then an internal laryngeal branch which runs with the internal laryngeal branch of the superior laryngeal nerve; lower down a crico-thyreoid branch arises from it and, just as it disappears, a sterno-mastoid branch which crosses the common carotid artery and the internal jugular vein to reach the muscle. (2) The **lingual** artery arises just above the great cornu of the hyoid bone. It first forms a small loop convex upwards and then runs forwards and disappears under the posterior border of the hyoglossus muscle. The hypo-

glossal nerve lies superficial to it (Fig. 23). It gives off a small suprahyoid branch. (3) The **ascending pharyngeal** artery springs from the medial side of the commencement of the external carotid artery and ascends on the wall of the pharynx in the interval between the internal and external carotid stems. (4) The **facial** artery arises immediately below the posterior belly of the digastric muscle and almost at once disappears under cover of it. (5) The **occipital** artery takes origin at the lower border of the posterior belly of the digastric muscle and passes under it. It gives off a sterno-mastoid branch which passes downwards and backwards, and hooking round it at its origin there will be found the hypoglossal nerve.

The lower end of the parotid gland should then be pushed upwards, and emerging from under cover of the posterior belly of the digastric muscle the **accessory** (eleventh cranial) **nerve** should be secured (Fig. 23). It passes (usually) superficial to the internal jugular vein and enters the sterno-mastoid muscle, as a rule accompanied by a small artery, a branch of the occipital artery.

In the **muscular triangle** the slender, ribbon-like **infra-hyoid muscles** are to be examined. They are arranged in two layers, the **omo-hyoid** and the **sterno-hyoid** forming the superficial layer and the **sterno-thyreoid** and the **thyreo-hyoid** the deep layer. These muscles are concerned in the movements of the larynx and the hyoid bone chiefly in the act of swallowing, acting as depressors of those parts after they have been raised with the pharynx. They are supplied by branches of the ansa hypoglossi.

The **omo-hyoid** muscle consists of two fleshy bellies united by an intermediate tendon (Fig. 23). The posterior belly was examined in the dissection of the posterior triangle. It was traced under the sterno-mastoid muscle where it ends in the central tendon (p. 57). This tendon is held in position by a strong process of fascia which is attached below to the sternum and the first costal cartilage. The anterior belly emerges from under the sterno-mastoid and passes almost vertically upwards close to the lateral border of the sterno-hyoid muscle. It is inserted into the lateral part of the lower border of the hyoid bone. The omo-hyoid muscle is one of the most variable in the body. The commonest variation is an attachment to the clavicle which may be the sole origin of the posterior belly or may be a supernumerary belly. The anterior belly is sometimes fused with the sterno-hyoid.

The **sterno-hyoid** muscle arises from the posterior surface of the medial end of the clavicle, the upper and posterior part of the manubrium sterni, and the capsule of the sterno-clavicular articulation. It is inserted into the lower border of the body of the hyoid bone. There is sometimes a transverse tendinous inscription in it a short distance above the sternum. The muscles of the opposite sides are separated

from one another below, but about the middle of their course they come closer together and from this upwards lie side by side.

The sterno-hyoid is to be divided as low down as possible and turned upwards towards its insertion, and its nerve of supply from the ansa hypoglossi should be secured. The two deeper muscles of this group are then to be cleaned and examined, the omo-hyoid being displaced as much as is necessary to define the thyreo-hyoid.

The **sterno-thyreoid** is a shorter and broader muscle than the sterno-hyoid under cover of which it lies. It arises from the posterior surface of the manubrium sterni and from the edge of the cartilage of the first rib, and is inserted into the oblique line on the lamina of the thyreoid cartilage. Occasionally there is an incomplete tendinous intersection about the centre of the muscle. At their origin the muscles of the two sides are in contact, but as they ascend they diverge from one another.

The **thyreo-hyoid** is a small quadrilateral muscle and appears to be the upward continuation of the sterno-thyreoid. It arises from the oblique line on the lamina of the thyreoid cartilage and is inserted into the lower border of the great cornu of the hyoid bone. It covers the lateral part of the thyreo-hyoid membrane and passing under it from behind to pierce the membrane there have already been secured the internal laryngeal nerve and the laryngeal branch of the superior thyreoid artery. Its own nerve is a branch of the hypoglossal nerve.

The sterno-thyreoid muscle is to be divided as low as possible and turned upwards towards its insertion, and its nerve from the ansa hypoglossi should be traced to it. The thyreo-hyoid branch of the hypoglossal nerve should then be examined again; and if the external laryngeal nerve was not found before it should be sought now along the upper edge of the sterno-thyreoid muscle. It is accompanied there by the crico-thyreoid branch of the superior thyreoid artery. The **lateral lobe** of the **thyreoid gland** is now exposed and below it a small part of the side of the trachea (Fig. 23).

The **sterno-mastoid** muscle is now to be examined, its surface being carefully cleaned from its origin to its insertion and its anterior border sharply defined. It stretches obliquely along the whole length of the side of the neck and divides it into the two great triangles, anterior and posterior. The following relations of its anterior border are to be carefully noted: (1) that it covers the posterior part of the lateral lobe of the thyroid gland (Figs. 21 and 23); (2) that only a small part of the upper end of the common carotid artery and the lower parts of the internal and external carotid arteries are visible in front of it—the common carotid artery, indeed, may be entirely concealed; (3) the internal jugular vein lies in front of it, if at all, only in the upper and posterior angle

of the carotid triangle; not uncommonly, however, it is entirely hidden beneath the muscle. It is not possible, therefore, to examine the course and relations of the great vessels of the neck until the sterno-mastoid muscle has been reflected, or, as in an operation on the living subject, it is forcibly retracted backwards. Its surface should therefore be cleaned, and the external jugular vein and the great auricular and transverse cervical nerves turned from it. Into its deep surface there should be followed the sterno-mastoid branches of the superior thyreoid and occipital arteries, and just above the occipital branch the accessory nerve is to be secured as it passes through the deeper fibres of the muscle. The attachments of the muscle should now be examined.

The **sterno-mastoid** (sterno-cleido-mastoid) muscle is a long oblique muscle which extends the whole length of the neck (Fig. 21). It is attached below in two parts, one to the anterior surface of the manubrium sterni and the other to the upper surface of the medial third of the clavicle. The sternal head is thick and rounded and tendinous on the surface, but the clavicular head, separated from the sternal head by a variable interval, is flat and composed of more fleshy fibres. The two heads meet and form a thick muscle which extends upwards, laterally and backwards, and is inserted by short tendinous fibres into the surface of the mastoid process and the lateral half or more of the superior curved line of the occipital bone.

The sterno-mastoid muscle is to be divided close to its origin and turned upwards towards its insertion; the arteries which supply it may be divided as they enter its substance, but the accessory nerve is to be dissected from among its fibres (Fig. 23).

It is convenient at this stage of the dissection, and it meets the requirements of the dissectors of the arm, to remove the clavicle and thus display the structures at the root of the neck. This is best done by disarticulating the bone at the **sterno-clavicular joint,** the structure of which can be studied during the dissection. The fibres of origin of the sterno-mastoid muscle will require to be completely removed from both bones and from the fibrous capsule which stretches between them. This capsule is then to be cleaned, its structure examined, and its attachments defined (Fig. 24).

The **sterno-clavicular joint** is surrounded by a fibrous capsule which is of considerable thickness in front and behind but very thin below; above there is a dense band of fibres, the **interclavicular ligament**, which passes between the sternal ends of the clavicles. It dips into and is attached to the notch on the upper margin of the sternum. The **costo-clavicular** or **rhomboid ligament** is an accessory ligament of the joint. It is a short, flat, strong band, attached below to the upper and medial part of the first costal cartilage and above to a rough marking on the under surface of the clavicle near its sternal end. The subclavian vein lies behind it.

The capsule is to be removed from the front of the joint to expose the strong **articular disc** of fibro-cartilage which is interposed between the articular ends of the sternum and the clavicle and divides the joint cavity into two chambers. It is attached above to the clavicle and below to the cartilage of the first rib close to the sternum (Fig. 24). It is to be cut across at its clavicular attachment, and after dividing the rhomboid ligament and the posterior capsule of the joint the clavicle can be displaced from its socket. The articular fibro-cartilage and the surfaces of the bones forming the joint can then be conveniently examined.

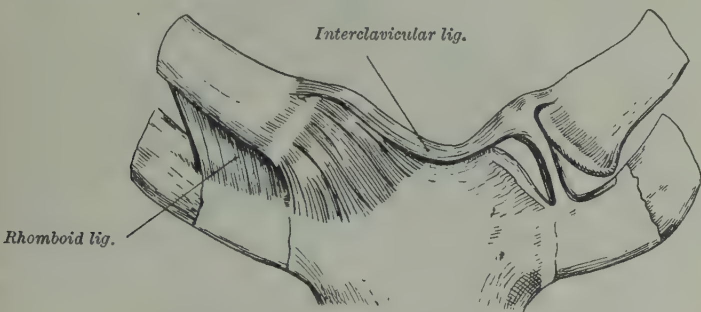


FIG. 24.

*The sterno-clavicular joints.* On the one side the capsule has been removed to show the two cavities of the joint and the articular fibro-cartilage. Note that the first costal cartilage forms part of the socket for the clavicle.

The **articular disc** is nearly circular in form. It is attached above to the medial end of the clavicle, and below to the cartilage of the first rib. It is thin and is prolonged laterally beneath the clavicle at its lower attachment, but otherwise it is thicker at its margin than at its centre, where indeed it is occasionally defective. There are two synovial cavities in the joint, one on each side of the disc ; the lateral is the more extensive. The articular surfaces of the clavicle and sternum are curved, but are not congruent, and that of the clavicle is considerably larger than the opposed surface of the sternum. The socket in which the clavicle plays, however, is not confined to the sternum, but extends on to the first costal cartilage which comes into contact with the lower and lateral part of the head of the clavicle. The covering layer of both articular surfaces is mainly fibro-cartilage, that on the clavicle being much thicker than that on the sternum.

Returning to the dissection of the neck, the dissector will note that under the sterno-mastoid muscle there is a considerable amount of fascial tissue which surrounds the underlying structures

of the neck and in which there are embedded a large number of lymph glands. Before these glands are dissected and the other structures cleaned, the dissector should examine very carefully a transverse section of the neck to learn the general position and relations of the great vessels and nerves he is about to study, and

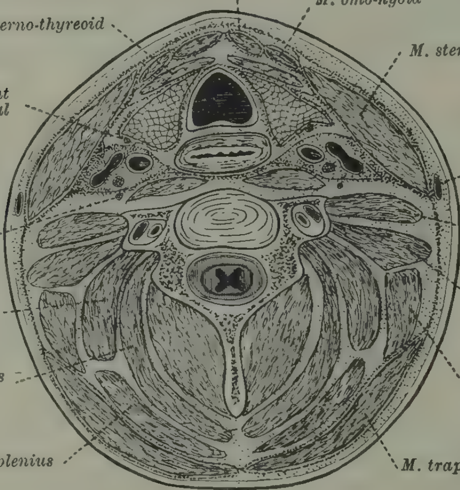


FIG. 25.

*Transverse section of the lower part of the neck* (*diagrammatic*). In the foramina of the transverse processes the vertebral vessels are seen. In front of the body of the vertebra lie the prevertebral muscles, and in front of them are the œsophagus and trachea; the lateral lobes of the thyreoid gland embrace the trachea. All the structures of the neck are embedded in connective tissue which is condensed at certain places to form fascial planes (see text); the carotid sheath, for example, surrounding the common carotid artery, the internal jugular vein and the vagus nerve, is easily recognised.

at the same time to understand the arrangement of the **deep cervical fascia**. For this purpose Fig. 25 should be examined and the different structures shown there are to be named.

The **deep cervical fascia** forms a general investing layer for the neck and, in addition, surrounds and embeds the various structures which are situated more deeply. This deep connective tissue is condensed at some places more than at others, and thus forms sheets which are described

as layers and given definite names. These parts are the **pretracheal** and **prevertebral layers** and the **carotid sheath**. The general **investing layer** has already been described. As seen on the transverse section it covers the anterior triangle of the neck, and when followed laterally on each side splits to enclose the sterno-mastoid muscle; behind this muscle it roofs the posterior triangle, and at the anterior border of the trapezius splits again and is conducted along the surfaces of that muscle to the vertebral spines where it fuses with the ligamentum nuchæ. The **carotid sheath** is a condensation of the fibrous tissue round the common and internal carotid arteries, the internal jugular vein, and the vagus nerve; and these structures are to be regarded as embedded in the connective tissue and not as enclosed in a hollow tube. Over the arteries the sheath is thick and strong, but over the internal jugular vein it is very much thinner. In front and behind it is fused with the pretracheal and prevertebral fascial planes. The **pretracheal layer** ensheaths the infrahyoid group of muscles, and behind them lies in front of the trachea and larynx. The relationship of the layer to the thyreoid gland is its most important character; it provides a fascial sheath for the gland. When traced laterally it passes in front of the carotid sheath and blends with the fascia on the deep surface of the sterno-mastoid muscle. The **prevertebral layer** covers the muscles in front of the vertebral column, and on them it extends up to the base of the skull, to which it is attached. The fascia ends below in the thoracic region by blending with the anterior ligaments of the vertebral column. Traced laterally, in the neck, it passes behind the carotid sheath and covers the scalene muscles, and from them extends on to the muscles in the floor of the posterior triangle, namely, the levator scapulæ and splenius muscles (p. 31). Lying on it in the front of the neck are the pharynx and œsophagus; while behind it there are placed the anterior divisions of the cervical nerves, forming the cervical and brachial plexuses, and the subclavian artery.

The structures which lie below the sterno-mastoid muscle are now to be defined and studied, commencing with the **anterior divisions** of the **cervical nerves** (Fig. 23). The second to the eighth nerves are easily found as they emerge between the muscles attached to the transverse processes of the cervical vertebræ, but the first nerve must be left at present; it will be exposed later. It will be noted at once that the second, third, and fourth nerves unite to form two loops, and, if the internal jugular vein be pulled forwards, part of the second nerve will be seen to ascend deep to the vein and in front of the transverse process of the atlas to join the first nerve. This series of loops is the **cervical plexus**; and towards it there should be traced the **communicans hypoglossi**, the **small occipital**, the **great auricular**, the **transverse cervical**, and the **supraclavicular** nerves, which take origin from the roots of the plexus. The chief branch of the plexus, however, is the **phrenic nerve**, which arises mainly from the trunk of the fourth nerve and descends on the surface of the **scalenus anterior** muscle deep to the prevertebral layer of the deep cervical fascia. It passes below the omo-hyoid muscle and over the subclavian artery into

the thorax (Fig. 23). Running parallel with it on its medial side there is a remarkably constant artery, the **ascending cervical** branch of the **inferior thyreoid artery**.

The **cervical plexus** is formed by the anterior divisions of the upper four cervical nerves, each of which, except the first, divides into upper and lower branches which unite to form three loops (Fig. 26). The plexus lies opposite the upper four cervical vertebræ, under cover of

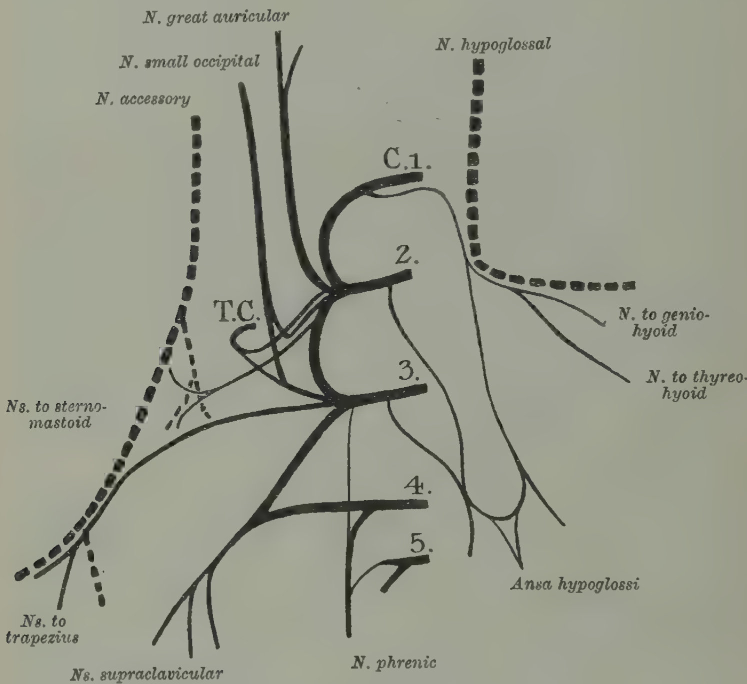


FIG. 26.

*Diagram of the cervical plexus.*

T.C. Transverse cervical nerve. Note how the ansa hypoglossi is formed by fibres from the cervical nerves.

the sterno-mastoid muscle, the first loop being placed between the internal jugular vein and the transverse process of the atlas, and the second and third loops on the surface of the scalenus anterior muscle. The first loop is connected to the hypoglossal nerve, and the trunks of the four nerves are connected by grey rami communicantes to the superior cervical sympathetic ganglion.

The **branches** of the plexus are arranged in two groups, superficial and deep. The superficial branches, namely, the small occipital, great auricular, transverse cervical and supraclavicular nerves, have already

been dissected and followed to their cutaneous distribution. The deep branches are motor nerves, and the great majority of them run backwards to be distributed to the muscles of the neck, namely, the sterno-mastoid and trapezius (directly and through communications with the accessory nerve), the levator scapulæ, the scalenus medius, and the muscles of the prevertebral group (rectus capitis lateralis, rectus capitis anterior, longus capitis and longus colli muscles). Two branches of the deep group, however, run forwards, namely, the **phrenic nerve** and the **communicans hypoglossi** (Fig. 23).

The **phrenic nerve** arises chiefly from the fourth cervical nerve, but receives a branch from the third, and usually another from the fifth nerve. In its course through the neck, it lies on the surface of the scalenus anterior muscle deep to the prevertebral fascia, and is crossed there by the posterior belly of the omo-hyoid muscle (Fig. 23), and the transverse cervical and suprascapular arteries, and on the left side by the thoracic duct; and it is usually overlapped by the internal jugular vein. At the root of the neck it crosses in front of the first part of the subclavian artery and then lies behind the subclavian vein; and as it enters the thorax it passes either anterior or posterior to the internal mammary artery (Fig. 27).

The phrenic nerve contains both motor and sensory fibres, and its importance lies in the fact that it is the main nerve to the diaphragm. It gives off no branches in the neck but sometimes it is connected to the nerve to the subclavius muscle.

The **communicans hypoglossi** arises by two filaments, one from the second and the other from the third cervical nerve (Fig. 26). It passes downwards, usually on the lateral side of the internal jugular vein, and crossing in front of the vein a little below the middle of the neck joins the descendens hypoglossi in front of the sheath of the carotid artery and forms the loop named the ansa hypoglossi. The fibres which run in the descendens hypoglossi, and also those which pass to the thyreo-hyoid and genio-hyoid muscles, are derived from the first cervical nerve; the infrahyoid muscles, therefore, are innervated from the cervical plexus (Fig. 26).

The **brachial plexus** should now be reviewed. It is dissected by the dissectors of the arm whom the dissectors of the head and neck should assist. The plexus is formed by the anterior divisions of the fifth, sixth, seventh, and eighth cervical and first thoracic nerves, and there is usually a communication from the fourth cervical nerve, and sometimes one from the second thoracic nerve. These nerves appear in the interval between the scalenus anterior and medius muscles and are termed the **roots** of the **plexus**.

The **roots** of the **brachial plexus** appear in the posterior triangle of the neck, and when traced laterally join with one another and divide again in a remarkably constant manner. The fifth and sixth nerves join to form an upper trunk; the seventh continues distally as a middle trunk; while the eighth cervical and first thoracic nerves join to form a lower trunk. These **trunks** lie on the surface of the scalenus medius muscle somewhat above the third part of the subclavian artery, but the lowest of them passes behind that vessel. Each of the three trunks splits into an anterior and a posterior **division**, and these reunite to form the three **cords** of the plexus which enter the axilla more or less on the lateral

side of the first part of the axillary artery. The three posterior divisions unite to form the posterior cord, and of the anterior divisions the upper two unite to form the lateral cord, while the lowest anterior division continues distally by itself as the medial cord. From these cords the terminal branches of the plexus arise and will be dissected by the dissectors of the arm. There are certain branches, however, which arise from the upper parts of the plexus and are to be dissected by the dissectors of the head and neck: (1) The **long thoracic** nerve arises from the roots of the brachial plexus by three branches. The upper two of these, one from the fifth, and one from the sixth cervical nerve, pierce the scalenus medius muscle, but the lowest branch, from the seventh cervical nerve, passes over the surface of this muscle. The two parts of the nerve descend behind the brachial plexus to the serratus magnus muscle. (2) The **nerve** to the **rhomboids** arises from the lateral margin of the fifth cervical nerve and also pierces the scalenus medius muscle. It then disappears under the levator scapulæ muscle to reach its distribution on the back. (3) The **suprascapular** nerve should be secured at its origin from the upper trunk, and followed laterally with the suprascapular artery. (4) The **nerve** to the **subclavius** muscle arises from the anterior surface of the upper trunk, and passes downwards in front of the brachial plexus and the third part of the subclavian artery. In addition to these branches there are small twigs which arise from the nerve roots to supply the scalene muscles and the lower parts of the cervical prevertebral muscles. These will be secured later.

The student must now proceed to study the **common carotid artery** as the main vessel of the neck. The fascial sheath around the artery and the thinner layer which invests the accompanying **internal jugular vein** is to be completely removed, and behind and between these vessels the **vagus nerve** is to be secured. On the right side the nerve is to be followed downwards till it crosses the anterior surface of the **subclavian artery**, at which point its **recurrent** (inferior) **laryngeal** branch, which hooks round that vessel, is to be secured; on the left side the nerve descends somewhat medial to the subclavian artery and on an anterior plane. That the parts at the root of the neck may be more easily dissected, it is advisable to remove completely the lower parts of the sterno-hyoid and sterno-thyreoid muscles. Behind the common carotid artery, and covered by the prevertebral fascia, the dissector must isolate and carefully clean the cervical part of the **sympathetic trunk**. It is to be followed upwards till the lower part of the **superior cervical ganglion** is reached and downwards till it is crossed, either anteriorly or posteriorly, at the level of the cricoid cartilage, by the **inferior thyreoid artery**. The common carotid artery should then be displaced laterally to expose the side of the **trachea** and the lateral margin of the **œsophagus**; and in the angle between these structures there is easily secured the **recurrent** (inferior) **laryngeal** branch of the **vagus** nerve. It is to be followed

upwards until it disappears below the lateral lobe of the thyreoid gland. On the left side of the body the student must seek the **thoracic duct**. It is a very thin-walled vessel and is often pulled away in the belief that it is merely fibrous tissue. The duct is most readily found if the lower ends of the internal jugular vein and the common carotid artery be displaced forwards, for the duct turns laterally behind them a little below the level of the cricoid cartilage. It crosses in front of the **vertebral artery** and then turns downwards and arches over the subclavian artery to end in the angle of junction between the internal jugular and subclavian veins.

The **common carotid artery** commences differently on the two sides of the body. On the right side it commences by the bifurcation of the innominate artery into common carotid and subclavian arteries, but on the left side it arises directly from the arch of the aorta. Both vessels enter the neck behind the sterno-clavicular joints and from there their course through the neck is identical on the two sides (Fig. 23). Each artery runs upwards and slightly laterally, and would be sufficiently indicated on the surface by a line drawn from the medial end of the clavicle to the front of the mastoid process. The common carotid artery ordinarily ends at the level of the upper border of the thyreoid cartilage by dividing into the **internal** and **external carotid** arteries. As a rule no other branches arise from it, but occasionally the superior thyreoid or the ascending pharyngeal arteries take origin from it instead of from the external carotid artery. This is more common when the division of the vessel is at a higher level than usual.

The relations of the **common carotid artery** should be studied on a transverse section of the neck, as they are then more easily understood (Fig. 25). The student is specially warned against attempting to learn them by memory from the description given below. The superficial relations of the artery have already been removed, namely the skin, the superficial fascia and the platysma muscle, the deep fascia and the anterior margin of the sterno-mastoid muscle. The lower part of the vessel lies more deeply than the upper part and is also covered by the sterno-hyoid and sterno-thyreoid muscles. In addition to these general coverings the artery is crossed by the superior thyreoid vein and the sterno-mastoid branch of the superior thyreoid artery, lower down by the middle thyreoid vein, and at the root of the neck by the anterior jugular vein which is separated from it, however, by the infra-hyoid muscles; spreading out in front of it there are the branches of the ansa hypoglossi, and it is overlapped from the lateral side by the anterior margin of the internal jugular vein. The artery rests behind on the transverse processes of the lower three cervical vertebræ which are covered by the lateral parts of the prevertebral muscles (the longus colli and longus capitis), and the origin of the scalenus anterior. The inferior

thyreoid artery passes medially behind the artery at the level of the cricoid cartilage, while the vertebral artery intervenes between it and the transverse process of the seventh cervical vertebra. On the right side the recurrent branch of the vagus nerve passes behind it, while on the left side the thoracic duct runs laterally between it in front and the vertebral artery behind. On the medial side of the artery lie the trachea and the œsophagus and, in the interval between them, the recurrent laryngeal nerve; and at a higher level there are the larynx and the pharynx. The lateral lobe of the thyreoid gland lies on the medial side of the artery, but very frequently it also forms a direct anterior relation. On the lateral side there is the internal jugular vein which accompanies the artery in its whole length; and the vagus nerve lies posterior to it.

**Carotid body.**—At this stage of the dissection the student should seek the carotid body, a small, oval, reddish-brown structure which lies on the posterior surface of the common carotid artery at the angle of its bifurcation. The best means of finding it is to turn the whole vessel round so that its posterior surface is twisted to the front. The body is closely connected with the sympathetic filaments on the carotid vessels and numerous small arterial twigs enter it from them. Its function is as yet unknown, but probably it belongs to the group of the ductless glands; in structure it somewhat resembles the medulla of the suprarenal gland.

The student must now proceed to study the **subclavian arteries,** which at their commencement lie deeply in the root of the neck, and, especially on the left side, are considerably hidden by the large veins related to them. On this account it is usually advisable to cut across the internal jugular vein at its lower part, after having tied it with two ligatures; it can then be drawn well aside and the first part of the subclavian artery will be exposed. In relation to the anterior surface of this part of the artery there have to be secured the **vagus nerve** and a loop of the **sympathetic trunk** named **the ansa subclavia** (Vieussens).

The **subclavian artery** arises differently on the two sides of the body; that of the right side commences at the bifurcation of the innominate artery but that of the left arises directly from the arch of the aorta. On each side the vessel enters the neck behind the sterno-clavicular joint and pursues an arched course across the root of the neck (Fig. 27). It rests behind on the anterior surface of the dome of the pleura a short distance below its summit and then crosses the upper surface of the first rib; and at the lateral margin of the rib it becomes the **axillary artery.** In its course the subclavian artery passes posterior to the scalenus anterior muscle and is conveniently divided into three parts by its relation to it; the first part extends from the origin of the vessel to the medial border of the muscle, the second lies behind the muscle, and the third extends from the lateral border of the muscle to the lateral

border of the first rib (Fig. 27). The relations of the first part are a little different on the two sides on account of the difference in their origin, but the relations of the second and third parts are the same on the two sides.

The **first part** of the artery is placed deeply on both sides, lying

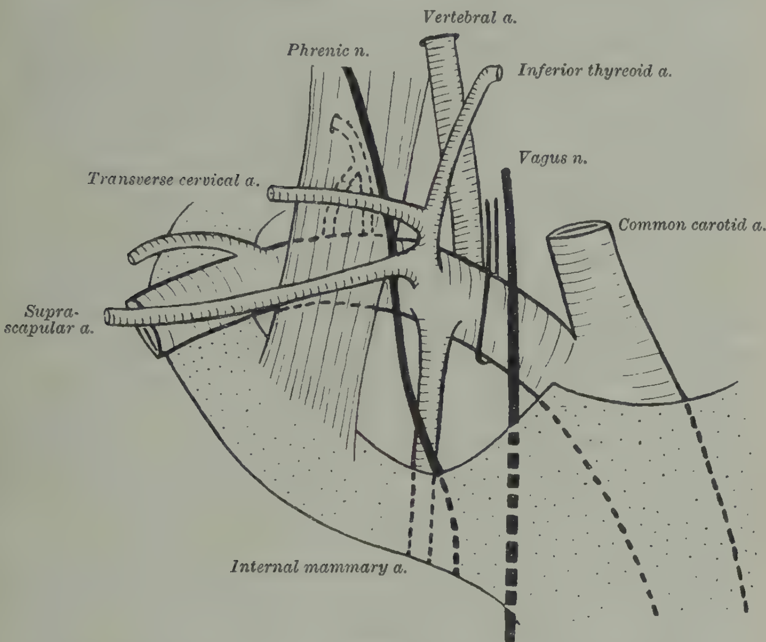


FIG. 27.

*Diagram of the right subclavian artery and its branches.* The scalenus anterior muscle crosses the artery and divides it into three parts. The ansa subclavia crosses the first part close to the vagus; arising from the second part, behind the muscle, is the superior intercostal artery; and from the third part there is shown an additional branch, which most commonly corresponds to the posterior scapular artery.

under cover of three muscular layers, namely, the sterno-thyreoid, sterno-hyoid, and sterno-mastoid muscles, as well as the superficial fascial structures which cover them. It is crossed by the internal jugular and the vertebral veins and by the anterior jugular vein, which, however, is separated from it by the two infra-hyoid muscles. The vagus nerve and the ansa subclavia also lie anterior to it. On the left side these veins and nerves are placed more or less parallel to the artery owing to its almost vertical direction; on the right side they cross the vessel, which passes obliquely laterally and upwards. The peculiar relations of the two sides are that on the right the recurrent

branch of the vagus nerve hooks round its lower border, while on the left side the phrenic nerve and the left innominate vein lie in front of it and the thoracic duct arches over it. On both sides the artery rests behind on the dome of the pleura.

The **second part** of the artery forms the summit of the arch. It has the same relations on the two sides of the body. It lies behind the scalenus anterior muscle which itself is covered by the clavicular origin of the sterno-mastoid muscle and the cervical fasciæ. It rests behind on the dome of the pleura a little below its summit and on a small part of the scalenus medius muscle; and the part of the first thoracic nerve which joins the brachial plexus ascends behind it. The subclavian vein is below the level of the artery at this point and is separated from it by the scalenus anterior. On the right side the phrenic nerve is usually carried over the artery on the surface of the scalenus anterior muscle, but on the left side it slips over the margin of the muscle and crosses the first part of the artery.

The **third part** of the artery was dissected and described in the posterior triangle of the neck (Fig. 21 and p. 58).

The **branches** of the **subclavian artery** are four in number. Three of these, the **vertebral**, the **thyreoid axis**, and the **internal mammary** arteries, as a general rule take origin from the first part and one, the **superior intercostal** artery, from the second part. In a great number of subjects, however, a branch of considerable size will be found arising from the third part; most frequently this is the **posterior scapular** artery arising directly from the subclavian instead of, as is more common, from the thyreoid axis. The branches are to be followed out as far as is possible in the present dissection (Fig. 27).

The **vertebral artery**, the first branch of the subclavian artery, is seen in only a small part of its course. It arises from the posterior part of the upper border of the subclavian trunk (though occasionally on the left side it arises from the aorta), and runs upwards in front of the transverse process of the seventh cervical vertebra in the interval between the scalenus anterior and the longus colli muscles. It enters the foramen in the transverse process of the sixth cervical vertebra, and passes through the corresponding foramina in all the vertebræ above (second part, p. 164); and in the suboccipital triangle (third part, p. 44) it winds medially to enter the foramen magnum, and in the skull it supplies the brain (fourth part, p. 216). It is about two inches in length in the first part of its course, that is between its origin and the point at which it enters the foramen in the transverse process of the sixth vertebra, and it is deeply placed. In front of it there are the inferior thyreoid artery, the middle cervical ganglion, and the internal jugular and vertebral veins; and on the left side there is also the thoracic duct. (The artery sometimes enters the foramen of a vertebra higher than the sixth, most commonly that of the fourth.)

The **vertebral vein**, as a rule smaller than the artery, emerges from the foramen in the sixth vertebra, and passes downwards in front and on the lateral side of its companion vessel. It lies behind the internal jugular vein, and near its termination crosses the subclavian artery to open into the commencement of the innominate vein. It receives the

deep cervical vein (p. 40). (Sometimes it escapes through the foramen in the transverse process of a vertebra other than the sixth.)

The **internal mammary artery** arises from the lower part of the anterior surface of the subclavian artery directly below the origin of the thyreoid axis, and descends behind the clavicle into the thorax (Fig. 27). It lies on the surface of the cervical pleura and passes behind the medial end of the subclavian vein ; and it is crossed there from the lateral side by the phrenic nerve. The **venæ comites** which accompany the artery join the innominate vein, so that the artery is not accompanied by a vein in the neck.

The **thyreoid** (thyreo-cervical) **axis** is a short thick trunk which arises from the anterior surface of the subclavian artery close to the medial border of the scalenus anterior muscle. It divides almost immediately into three branches, the **inferior thyreoid**, the **transverse cervical**, and the **suprascapular** arteries (Fig. 27).

The **inferior thyreoid** artery first runs upwards, behind the internal jugular vein and in front of the vertebral artery, then at the level of the cricoid cartilage it bends medially and descends along the posterior border of the thyreoid gland. The middle cervical sympathetic ganglion usually rests on the curve, and the recurrent laryngeal nerve runs upwards generally behind, but sometimes in front of the artery. The branches to the gland, one of which ascends along the posterior border, supply the lower and posterior parts of the lateral lobe. The artery gives off in addition œsophageal and tracheal twigs, a small inferior laryngeal branch which accompanies the recurrent laryngeal nerve to the larynx, and close to its origin the **ascending cervical** artery. This is a remarkably constant branch which runs upwards on the transverse processes of the cervical vertebræ in the interval between the scalenus anterior and longus capitis muscles. It gives twigs to the muscles and small branches pass from it into the spinal canal.

The **inferior thyreoid veins** are large vessels which issue from the lateral lobes of the thyreoid gland, and pass downwards in front of the trachea. They communicate freely with one another, almost forming a plexus below the isthmus of the gland, and open below into the innominate veins ; sometimes, however, the two veins unite to form a common trunk which enters either the left or the right innominate vein.

The **anterior vertebral vein** accompanies the ascending cervical artery ; it opens into the vertebral vein as it issues from the foramen in the sixth cervical transverse process.

The **transverse cervical** and **suprascapular** arteries run laterally in front of the scalenus anterior muscle and the phrenic nerve, and in the posterior triangle of the neck they cross the brachial plexus (Fig. 21). The suprascapular artery lies behind the clavicle, the transverse cervical at a higher level. The latter vessel is frequently of small size or altogether wanting, and it, or one of its terminal branches (the superficial cervical and posterior scapular arteries), then arises from the third part of the subclavian artery (Fig. 27). This aberrant vessel is most frequently the posterior scapular artery, and as a rule it threads its way backwards among the trunks of the brachial plexus.

The **superior intercostal** artery arises from the upper and posterior aspect of the second part of the subclavian artery, close to the medial margin of the scalenus anterior muscle (Fig. 27). On the left side, however, it more usually springs from the first part. It runs upwards and backwards over the apex of the pleura to the front of the neck of

the first rib, where it divides into two branches. The **deep cervical** branch passes backwards between the neck of the first rib and the transverse process of the seventh cervical vertebra, and is distributed among the muscles of the back of the neck, where it was dissected (p. 40). The **superior intercostal** branch descends behind the pleura in front of the necks of the first and second ribs and is distributed in the upper two intercostal spaces after the manner of a posterior intercostal artery (Vol. II., p. 128).

The course and relations of the **subclavian vein** are now easily followed; and it should be inserted in Fig. 27 by the student himself. It commences at the outer border of the first rib as the continuation of the axillary vein, and it arches over the root of the neck behind the clavicle. In its whole course it lies anterior to and below the level of its companion artery. It is placed first on the groove on the upper surface of the first rib and then in front of the scalenus anterior muscle; and at the medial margin of this muscle, while it lies in front of the apex of the pleura, it joins the internal jugular vein to form the innominate vein. The external jugular vein terminates in it at the lateral border of the scalenus muscle. The thoracic duct opens into the left vein at its junction with the internal jugular vein.

The terminal part of the **thoracic duct** will be seen, if a careful dissection has been made, rising into the root of the neck at the left margin of the œsophagus. It is a small, thin-walled vessel, often mistaken for a vein, but it is constricted at intervals so as to present a beaded appearance. At the level of the seventh cervical vertebra it arches laterally and anteriorly, passing between the carotid sheath and its contents in front and the vertebral artery and vein and the ascending cervical artery behind; and then it turns downwards on the scalenus anterior muscle, passing in front of the phrenic nerve and the transverse cervical and suprascapular arteries, and arches over the first part of the subclavian artery to join the left innominate vein at the angle of union between the internal jugular and subclavian veins. It is closely related to the lowest of the deep cervical glands, and is, therefore, endangered in the operation for their removal when diseased. The thoracic duct receives the chyle and the lymph from the greater part of the body, the areas not so drained communicating with and being drained by the **right lymphatic duct**.

The **right lymphatic duct** is a smaller vessel than the thoracic duct, and is not often seen in an ordinary dissection. It commences in the posterior mediastinum of the thorax, where it may communicate with the thoracic duct, and ascends into the root of the neck along the medial margin of the scalenus anterior muscle. It ends in the right innominate

vein in the angle of union between the internal jugular and subclavian veins. It receives the lymph from (1) the right side of the head and neck; (2) the right arm; and (3) the right side of the thoracic wall, the right lung and the right side of the heart, and the right side of the diaphragm and the upper surface of the liver. The lymph channels from these three areas, however, frequently open separately into the jugular, subclavian, and innominate veins.

The **cervical pleura** (the dome of the pleura) has been referred to frequently in the present dissection, and the dissector should now examine it more carefully with the dissectors of the thorax and abdomen. It comprises that part of the pleural sac which rises above the level of the first rib into the root of the neck. Posteriorly, in most subjects, it rises as high as the neck of the rib, but the distance it extends above the anterior part of the rib varies between one and two inches. The differences depend on differences of obliquity in the thoracic inlet. The cervical pleura is covered and strengthened by a fascial expansion, **Sibson's fascia**, which is attached above to the transverse process of the seventh cervical vertebra and below to the medial margin of the first rib. In addition it is supported by the scalenus anterior and medius muscles. In relation to its anterior surface there have been dissected (1) the subclavian artery and its branches; (2) the vertebral, subclavian, and innominate veins; and (3) the vagus and phrenic nerves and, on the right side, the recurrent laryngeal nerve.

## THE PAROTID GLAND

(The student must now leave the dissection of the neck for a time and carry out a deep dissection of the face; for only after this is completed can he examine the course and relations of the upper parts of the great vessels and nerves of the neck.)

The **parotid gland** is the first structure to be dissected. If it be examined on a transverse section (Fig. 28), it is seen to be more or less a wedge-shaped body, the base of the wedge being the superficial surface; and to fill a more or less triangular interval, the parotid space, which is bounded in front by the ramus of the mandible and the muscles related to it, and behind by the mastoid and styloid processes and the muscles attached to them. The space extends upwards to the external auditory meatus and downwards into the carotid triangle of the neck, for the gland descends beyond the angle of the mandible. The gland is best described to have three surfaces, namely, a **superficial** surface which is at present exposed, an **antero-medial** surface facing forwards,

and a **postero-medial** surface directed backwards and medially. The superficial surface and its relations are to be carefully examined.

The **superficial surface** of the parotid gland is covered by the skin, the superficial and deep fasciæ, the deep fascia being continued upwards over it to be attached to the zygomatic arch; and in its lower part is also overlaid by the platysma and the risorius muscles. Embedded in it are a few lymph glands, which drain the anterior part of the scalp, the face above the level of the mouth, and the surface of the ear. The surface of the gland is rather triangular in shape. Posteriorly it reaches as far back as the mastoid process and the anterior border of the sterno-mastoid muscle; above it touches the lower border of the zygoma and the lower surface of the external auditory meatus; while its anterior edge overlaps the masseter muscle (Fig. 28). Its lower pointed extremity is wedged between the angle of the mandible and the anterior border of the sterno-mastoid muscle; it is usually in contact with the upper deep cervical glands and emerging from it there are the posterior facial vein and the cervical branches of the facial nerve. From the upper part of the gland there emerge and pass upwards the auriculo-temporal nerve, the temporal branches of the facial nerve, and the superficial temporal artery; and the posterior facial vein passes under cover of it. From beneath the anterior border there emerge the transverse facial artery and the transverse branches of the facial nerve, and passing forwards from it there is the duct of the gland.

The **duct** of the parotid gland, **Stensen's duct**, arises from the anterior part of the gland and runs transversely across the masseter muscle at the level of a line drawn from the lobule of the ear to a point midway between the ala of the nose and the red margin of the upper lip. At the anterior border of the masseter, it bends sharply round at right angles to its former course, and after piercing the buccinator muscle and the mucous membrane of the mouth it opens on the summit of a small papilla opposite the second molar tooth of the upper jaw (Fig. 28). Above the duct and close in front of the anterior margin of the gland, there is a small detached portion of gland substance, named the **socia parotidis**; its duct opens into the main duct.

It is extremely difficult to remove the parotid gland entire without damaging the structures which are related to it; it is, therefore, to be picked away in small pieces and, as this is carried out, the structures which pass through it can be preserved and those which form the relations of its anterior and posterior surfaces can be defined. The **facial nerve** and its branches are the most superficial structures in the substance of the gland (Fig. 28). The terminal branches of the nerve, which have been dissected on the face, are to be traced back into the gland where they will be found to arise from two main divisions; and these, when followed backwards over the posterior facial vein, form the trunk

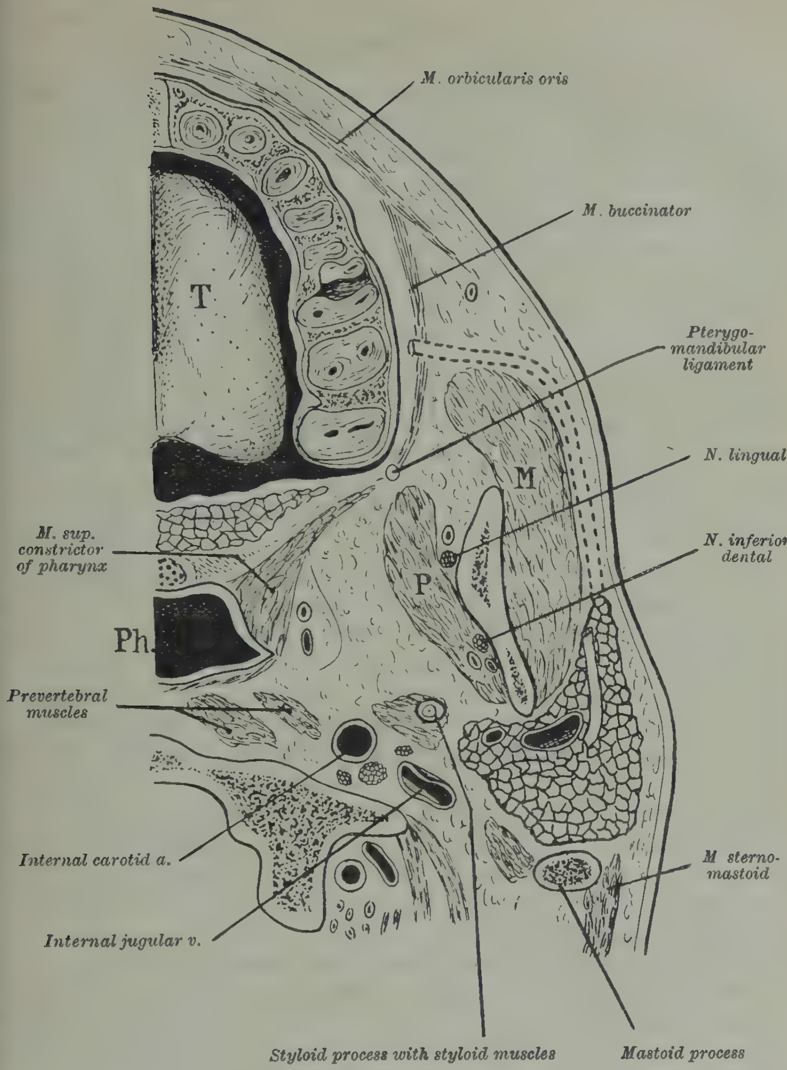


FIG. 28.

*Transverse section through the head at the level of the parotid gland.*

T. Tongue; Ph. Pharynx; M. Masseter muscle; P. Internal pterygoid muscle.

The relations of the structures shown in this diagram should be very carefully studied. In the substance of the parotid gland there are from without inwards, the facial nerve, the posterior facial vein, and the external carotid artery, while from the anterior part of its superficial surface the parotid duct, indicated in broken lines, runs forwards. On the medial side of the mastoid process is the posterior belly of the digastric muscle, and on the surface of the superior constrictor are the ascending pharyngeal vessels. The vertebra divided is the atlas.

of the nerve. The trunk can be followed backwards over the root of the styloid process to the stylo-mastoid foramen, through which the nerve issues from the skull; and there are to be secured arising from it the **posterior auricular** nerve and the **nerve** to the **stylo-hyoid** and the posterior belly of the digastric muscle. As the trunk of the nerve is being followed the **posterior auricular artery** will probably be exposed along the upper border of the digastric muscle; it passes either superficial or deep to the nerve to the back of the external meatus (Fig. 8). The **posterior facial vein** lies deeper than the facial nerve in the substance of the gland (Fig. 28). It receives the internal maxillary and the transverse facial veins, and at the lower end of the gland divides into anterior and posterior branches; the anterior branch joins with the anterior facial vein to form the common **facial** vein, and the posterior branch unites with the posterior **auricular** vein to form the external jugular vein (Fig. 22). Still deeper than the veins there will be found the upper end of the **external carotid artery**, which divides in the gland into its terminal branches, the superficial temporal and the internal maxillary arteries. The deepest parts of the gland have still to be picked away until the styloid process and the origin of the stylo-hyoid muscle are exposed and the posterior belly of the digastric can be followed to its origin on the mastoid process. The **internal jugular vein** and the **internal carotid artery** are to be brought into view as they pass under the posterior belly of the digastric muscle, and crossing them the **occipital artery** is to be cleaned as it runs upwards and backwards along the lower border of the digastric. The **accessory nerve** is also to be secured; it emerges from below the digastric muscle and crosses the internal jugular vein.

The relations of the antero-medial and postero-medial surfaces of the parotid gland are now defined and can be examined (Fig. 28).

The **antero-medial surface** rests against the posterior border of the ramus of the mandible and the internal pterygoid muscle which lies on its deep surface; a short process of the gland, the "pterygoid lobe," extends forwards between these two structures. More superficially the gland rests on the surface of the masseter muscle and is prolonged over it for some distance. This surface is pierced by the terminal branches of the facial nerve passing on to the face and the internal maxillary and transverse facial veins.

The **postero-medial surface** rests against the anterior surface of the mastoid process and the anterior border of the sterno-mastoid muscle. Medial to this lie the posterior belly of the digastric and the stylo-hyoid muscle, and still more medially the styloid process lies behind its upper part. Below the digastric muscle the gland rests on the internal jugular vein and the internal carotid artery, but the upper parts of these vessels

and the last four cerebral nerves are separated from it by the digastric muscle and the styloid process and the muscles attached to it.

The upper end of the gland is a concave surface and fits on to the under surface of the external auditory meatus, both the cartilaginous and the bony parts; the part of it which occupies the posterior part of the glenoid fossa is sometimes named the "glenoid lobe."

## THE TEMPORAL AND PTERYGOID REGIONS

The dissection of the temporal and pterygoid regions is essentially a dissection of the **muscles of mastication** (see p. 3), and, in the second place, of the vessels and nerves related to and supplying them, namely, the **internal maxillary artery** and the **mandibular** (third) **division** of the **trigeminal** (fifth cranial) **nerve** and their branches. In the course of dissection the student will also examine the **temporo-mandibular joint**, at which the muscles of mastication act.

The muscles of mastication are four in number. Two of them, the masseter and the temporal muscle, are comparatively superficial, but the other two, the external and internal pterygoid muscles, are more deeply placed. Their position and general relations are shown in Fig. 29. The **masseter** muscle is the first to be examined. Its surface is more or less completely exposed, but its fibres require to be cleaned to demonstrate their direction. The great bulk of them, as seen from the surface, run parallel with one another downwards and backwards from the zygomatic arch to the angle of the jaw, but behind these, at the upper end of the muscle, a small triangular area of a deeper layer can be defined (Fig. 5).

The **masseter** is a powerful quadrate muscle covering the ramus of the mandible. Its fibres are arranged in two sets, superficial and deep. The superficial fibres arise from the lower margin of the anterior two-thirds of the zygomatic arch and are directed downwards and backwards. The deep fibres are seen behind the superficial fibres. They are attached to the posterior third of the lower margin and the whole length of the deep surface of the zygomatic arch, and run downwards and very slightly forwards. Both groups of fibres are inserted on the outer surface of the ramus of the mandible between the coronoid process and the angle of the jaw, the superficial fibres reaching a lower level than the deep fibres. The origin of the deep fibres and the insertion of the muscle will be displayed when it is reflected.

The **temporal muscle** is the next to be examined. It arises from the side of the skull over the area of the temporal fossa and its fibres, converging strongly, passes downwards deep to the zygomatic arch to be inserted on the coronoid process of the

mandible (Fig. 29). Above the zygoma it is covered by a strong glistening membrane, the **temporal fascia**, the extent and attachments of which are to be studied before it is removed.

The **temporal fascia** is a strong aponeurotic layer which covers the temporal muscle over the area of the temporal fossa. The upper part of the fascia is thin and the fibres of the temporal muscle can be seen through it; in its lower part, however, it is much thicker and perfectly opaque. It is attached above to the upper of the two lines which form the temporal ridge on the side of the skull and in front to the margin of the zygomatic process of the frontal bone. It is attached below to the whole length of the zygomatic arch in two layers, the superficial to the upper margin of the arch and the deep to its medial surface (Fig. 29). Between the two layers there is a narrow space filled with fat which can be readily demonstrated by dividing the superficial layer close to its attachment and turning it upwards; if the fat be then scraped away the deeper layer will be brought into view.

The temporal fascia must be removed to display the temporal muscle. It should be detached from the zygomatic arch and turned upwards, and while doing so the dissector must preserve, if possible, the **middle temporal** branch of the superficial temporal artery which pierces it; at the same time he should note that some of the fibres of the temporal muscle are attached to its deep surface. The lower part of the temporal muscle can only be displayed by the removal of the zygomatic arch with the attached masseter muscle; and before this dissection is commenced the dissector is warned that while it is being carried out he must secure the **nerve** and **artery** to the masseter. The zygomatic arch must be sawn through as far back as possible without injuring the temporo-mandibular joint, and in front an oblique saw-cut is to be made through the malar bone; this incision should extend in front of the masseter from the extreme anterior end of the upper margin of the arch downwards and forwards to the point where the lower margin meets the zygomatic process of the maxilla. In making both of these incisions it is best only to saw partially through the bone and to complete the division with the bone forceps. The zygomatic arch, with the masseter attached to it, is now freed and is readily turned downwards; and as this is being done the **masseteric nerve** and **artery** which enter the deep surface of the upper part of the muscle from behind the posterior border of the temporal muscle will be found. They are to be divided and the reflection is to be continued to the angle of the mandible. The origin of the deep fibres of the masseter from the medial surface of the zygomatic arch and the insertion of the muscle to the ramus of the jaw can now be seen. The surface of the **temporal muscle** is now to be

cleaned. (Occasionally a few fibres from the temporal muscle join the masseter muscle and complicate the above dissection.)

The **temporal** muscle (Fig. 29) arises from the whole area of the temporal fossa between the lower temporal ridge above and the infratemporal crest on the great wing of the sphenoid bone. (On a skull the student should identify the various bones which lie in the temporal fossa

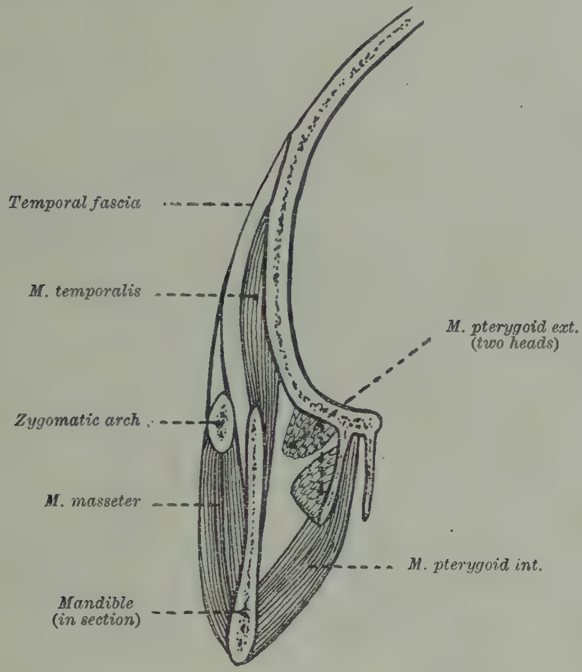


FIG. 29.

*Diagram of the position and relations of the muscles of mastication.*

and to which the muscle is attached.) In addition there are some fibres attached to the deep surface of the temporal fascia. The muscle fibres converge towards the coronoid process of the mandible, the anterior fibres passing almost vertically downwards and the posterior fibres almost horizontally forwards. Near its insertion, the muscle becomes tendinous on its surface, and is inserted on the summit and anterior edge of the coronoid process. The deep part of the muscle, however, remains fleshy and is inserted on the inner surface of the coronoid process and for a varying distance on the inner face of the ramus of the mandible; usually it reaches as far as the last molar tooth. This deep insertion cannot be seen at present, but will be noted at a later stage of the dissection.

The temporal muscle is to be reflected upwards by separating

the coronoid process from the mandible. An oblique incision is to be made with the saw from the lower margin of the condylar notch downwards and forwards to the point where the ramus joins the body of the mandible. The saw-cut should not be carried quite through the bone but the division completed by striking the part to be detached sharply with the mallet. The coronoid process with the temporal muscle can now be turned upwards, but there is often some difficulty in defining the lower part of the muscle exactly when its insertion is carried far beyond the coronoid process. The **buccal nerve** and its accompanying artery are then in danger of being cut; they run downwards and forwards under cover of the temporal muscle, but not infrequently the nerve is embedded in its anterior fibres. These structures having been secured, however, the temporal muscle is to be separated with the handle of the knife from the lower part of the temporal fossa, and in doing so the **deep temporal arteries** and **nerves** which ascend between the cranial wall and the muscle are to be secured and cleaned.

The remaining muscles of mastication, the **external** and **internal pterygoid** muscles, are partly exposed, but the region in which they lie, the pterygoid region, is to be fully opened up by removing the greater part of the ramus of the jaw. This is to be done by sawing the bone transversely, first through the neck of the mandible and then just above the level of the **inferior dental foramen.** The level of the foramen may be found by passing the handle of a scalpel downwards on the deep surface of the ramus; it will be stopped at the foramen by the entrance of the **inferior dental vessels** and **nerve** into it. In making these incisions the saw should not be carried quite through the bone; the division should be completed with the bone forceps.

The contents of the pterygoid region are embedded in a fatty-areolar tissue which must be removed with some care to avoid injury to them. The dissection to be accomplished is shown in Fig. 30. The **external pterygoid** muscle, whose fibres run almost transversely to be attached to the neck of the mandible, should be defined first and then at its lower border the **internal pterygoid** muscle, whose fibres run downwards and backwards to the deep surface of the jaw. A few of the fibres of the internal pterygoid will be seen to lie on the surface of the lower part of the external pterygoid, but most of them pass deep to it. The **internal maxillary artery** is then to be cleaned if it lies on the surface of the external pterygoid muscle; frequently, however, it lies deep to the muscle, and then only its commencement and its end part can be defined. The

**nerves** of this space, branches of the **mandibular division** of the **trigeminal nerve**, are also to be found in relation to the external pterygoid muscle. At its upper margin there are the **masseteric** and the two **deep temporal** nerves; from its lower margin the **lingual** and **inferior dental** nerves descend on the surface of the internal pterygoid muscle; emerging from between its fibres, and

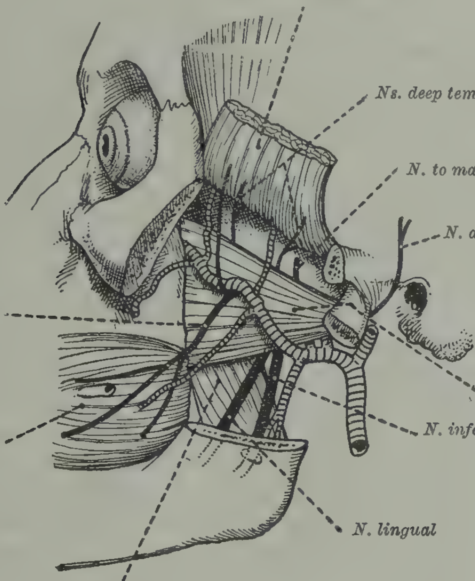


FIG. 30.

*Dissection of the pterygoid region.* The internal maxillary artery should be coloured and its branches named.

passing forwards, is the **buccal** nerve; while appearing from behind the neck of the mandible, and ascending in front of the ear, there is the **auriculo-temporal** nerve (Fig. 30). These structures are now to be studied in detail, commencing with the pterygoid muscles.

The **external pterygoid** muscle (Fig. 30) arises by two distinct heads. The upper of these springs from the infratemporal crest of the great wing of the sphenoid bone, while the lower arises from the lateral surface of the lateral pterygoid plate. The fibres of the two heads of the muscle converge as they pass backwards, and form a narrow musculo-tendinous bundle which is inserted on the anterior surface of the neck of the

mandible and into the capsular ligament and the anterior margin of the articular disc of the temporo-mandibular joint (Fig. 31).

The **internal pterygoid** muscle (Fig. 30) also arises by two heads, which embrace the origin of the lower head of the external muscle. The superficial and much the smaller head arises from the posterior part of the tuberosity of the maxilla and from the rough lateral surface of the tuberosity of the palate bone, while the deep head, which passes below the external pterygoid muscle, is attached to the medial surface of the lateral pterygoid plate and to that part of the tuberosity of the palate which appears in the fossa between the two pterygoid plates. The fibres of the two heads of the muscle proceed downwards and backwards and are inserted into the back part of the deep surface of the ramus of the mandible between the inferior dental foramen and the angle of the jaw.

The **internal maxillary artery** is the larger of the two terminal branches of the external carotid artery. It arises in the parotid gland, immediately behind the neck of the jaw, and runs forwards, deep to the jaw, to the anterior part of the pterygoid region where it disappears from view by passing between the two heads of the external pterygoid muscle and enters the spheno-maxillary (pterygo-palatine) fossa. For descriptive purposes it is divided into three parts, the details of which are as follows (Fig. 30) :—

The **first part** of the internal maxillary artery runs forwards between the neck of the mandible and the spheno-mandibular ligament, and crossing the inferior dental nerve, it passes over the lower margin on to the surface of the external pterygoid muscle. The **second part** lies on the surface of the external pterygoid muscle on which it extends obliquely upwards and forwards. In this position it is under cover of the insertion of the temporal muscle. While this is the more common arrangement, not infrequently the second part of the artery lies deep to the external pterygoid muscle. Even when this occurs, however, the artery usually makes a bend forwards in the interval between the two heads of the external pterygoid muscle and appears on its surface before entering the spheno-maxillary fossa. The **third part** dips between the two heads of the external pterygoid muscle to reach the spheno-maxillary fossa.

The **branches** of the **internal maxillary artery** are classified according to the portion of the vessel from which they arise (Fig. 30).

The **branches** of the **second part** are all distributed to the neighbouring muscles. They are: (1) the two **deep temporal** arteries, anterior and posterior, which pass up into the temporal fossa deep to the temporal muscle ; (2) a **masseteric** branch runs horizontally outwards behind the temporal muscle, and was seen to enter the deep surface of the masseter ; (3) the **pterygoid** branches are a number of twigs, uncertain in their origin and course ; and (4) the **buccal** branch accompanies the buccal nerve and supplies the buccinator muscle and the mucous membrane of the cheek.

The **branches** of the **first part** are : (1) the **deep auricular**, the **tympanic**, and the **middle meningeal** arteries which run upwards under cover of the external pterygoid muscle, and, therefore, cannot be studied until that

muscle is reflected; and (2) the **inferior dental artery** which runs downwards. It descends on the surface of the spheno-mandibular ligament to the inferior dental foramen into which it passes; but just before it enters the bone it gives off a small **mylo-hyoid** branch. It lies posterior to the inferior dental nerve and is generally accompanied by two venæ comites. It traverses the lower jaw in the dental canal and supplies the teeth, and appears as the mental artery at the mental foramen with the mental branch of the inferior dental nerve. The **mylo-hyoid** branch runs with the mylo-hyoid nerve in a groove on the deep surface of the mandible to the superficial surface of the mylo-hyoid muscle, where it was secured in the dissection of the digastric triangle.

The only branch of the **third part** which can be seen at present is the **posterior superior dental artery.** It descends on the posterior surface of the maxilla and gives off branches which enter the superior dental canals to supply the molar and bicuspid teeth; and others are distributed to the lining membrane of the maxillary antrum and to the gums.

The **veins** corresponding to the branches of the internal maxillary artery unite to form a plexus, named the **pterygoid plexus,** round the external pterygoid muscle, which, however, it will hardly be possible to dissect. This plexus is connected with the cavernous sinus of the skull and with the veins of the orbit, while passing forwards from it there is the deep facial vein which joins the anterior facial vein (p. 19). A short wide trunk, named the **internal maxillary vein,** arises from the posterior part of the plexus and runs backwards into the parotid gland and joins the posterior facial vein (Fig. 22).

The **temporo-mandibular joint** is to be examined at this stage of the dissection, so that afterwards the external pterygoid muscle may be reflected and the parts beneath it exposed. The joint is surrounded by a weak fibrous **capsule** which is attached below to the neck of the mandible and above to the margins of the articular fossa, reaching in front to the anterior margin of the articular eminence. Some of the fibres of the external pterygoid muscle are attached to it (Fig. 31). On its lateral surface there is a short thick band of fibres, broader above than below, which is attached above to the tubercle at the root of the zygoma and runs downwards and backwards to the neck of the mandible; it is named the **temporo-mandibular ligament.** On the medial side of the joint, and in great part already exposed, there is a long membranous band, the **spheno-mandibular ligament**; it is not part of the capsule but is conveniently described as an accessory ligament of the joint.

The **spheno-mandibular ligament** is a thin band, narrow above where it is attached to the spine of the sphenoid bone but broader below where it is fixed to the lingula at the inferior dental foramen. It is not in direct relationship with the joint, for intervening between it and the mandible there are, from above downwards, the external pterygoid

muscle and the auriculo-temporal nerve, the internal maxillary vessels, and the inferior dental vessels and nerve.

The **stylo-mandibular ligament** is also sometimes included as an accessory ligament of the joint. It is, however, merely a thickened portion of the deep cervical fascia which invests the parotid gland. It is attached above to the styloid process and below to the angle of the mandible.

The capsule is now to be removed from the lateral surface of the joint. Within the cavity there will be seen the **articular disc**, an oval plate of fibro-cartilage which is interposed between the head of


FIG. 31.

*Diagram of the structure of the temporo-mandibular joint.* The joint has been opened to show the articular disc separating the two synovial cavities. Note the insertion of the external pterygoid muscle into the anterior wall of the capsule.

the mandible below and the glenoid fossa and the eminentia articularis above. The disc is attached at its periphery to the articular capsule and thus divides the joint cavity into upper and lower parts, each of which is provided with its own synovial membrane (Fig. 31).

The **articular disc** is closely adapted to the two articular surfaces between which it lies. Its under surface is thus concave and is moulded over the condyle of the mandible, while its upper surface is concave in front over the eminentia articularis and convex behind where it is adapted to the glenoid fossa. It is thinner in the centre than at its margins; sometimes, indeed, it is perforated.

The **movements** of the **lower jaw**.—Before the condyle of the jaw is disarticulated, the student should study the movements which

can take place within the joint. They are of two kinds. In the upper compartment of the joint the movement is one of gliding, whereby the articular disc and the condyle of the jaw can be carried forwards until the condyle comes to rest on the eminentia articularis. This is the movement which takes place at the joint when the lower jaw is protruded; when it is retracted the disc and the condyle glide backwards. In the lower compartment, the condyle of the mandible can rotate on the lower surface of the articular disc, and in opening the mouth this rotation movement is combined with

FIG. 32.

*Diagram to show the position of the condyle of the mandible when the mouth is closed (solid line), and when it is open (broken line).*

the gliding movement in the upper compartment. The student can readily demonstrate this on himself by inserting his fingers in his ears; if the lower jaw is then depressed the condyles can be felt to move downwards and forwards over the posterior parts of the eminentiæ articulares, and when the mouth is closed they will be felt to pass back again into the glenoid fossæ.

The condyle of the jaw, with the articular disc attached to it, must now be disarticulated from the glenoid cavity, care being required, however, not to cut the auriculo-temporal nerve which lies close to the medial surface of the joint. When the condyle is freed, the external pterygoid muscle can be turned forwards and the parts beneath it brought into view. The **middle meningeal artery** and the two smaller branches, the **small meningeal** and the **tympanic** arteries which usually arise from it, are to be cleaned first.

The **middle meningeal artery** arises from the first part of the internal maxillary artery, and proceeds upwards deep to the external pterygoid muscle. It is usually embraced by the two roots of the auriculo-temporal nerve (Fig. 33). It enters the cranial cavity, within which it is distributed, through the foramen spinosum. It usually gives off the **small meningeal** artery, which runs forwards and upwards and enters the skull through the foramen ovale; this vessel may arise, however, directly from the internal maxillary artery. The **tympanic** artery runs upwards and backwards and enters the tympanic cavity, in which it is distributed, through the petro-tympanic (Glasserian) fissure.

A further small branch of the first part of the internal maxillary artery, the **deep auricular** artery, should also be sought. It pierces the anterior wall of the external auditory meatus, and is distributed to its walls and to the tympanic membrane.

The **mandibular** (third) **division** of the **trigeminal** (fifth cranial) **nerve** is now to be dissected. It enters the pterygoid region from the cranial cavity through the foramen ovale, and in it lies deep to the external pterygoid muscle, and on the surface of the **tensor palati** muscle and in front of the middle meningeal artery. It gives off two small branches, the **nervus spinosus** and the **nerve** to the **internal pterygoid** muscle, and almost immediately divides into two parts, which are named the **anterior** and **posterior divisions** (Fig. 33).

The **nervus spinosus** is a very slender twig which passes through the foramen spinosum with the middle meningeal artery. It terminates in the dura mater. The **nerve** to the **internal pterygoid** muscle runs downwards and passes under the upper end of the posterior border of the muscle.

The **anterior division** of the mandibular nerve is smaller than the posterior division. It is composed almost entirely of motor fibres which are distributed to the muscles of mastication; the only sensory fibres it contains are those which form the **buccal nerve** (Fig. 33).

The branches to the **temporal** muscle are usually two in number, anterior and posterior; the posterior is the smaller. They pass upwards into the temporal fossa from above the upper margin of the external pterygoid muscle (Fig. 30). The **masseteric** nerve often arises in common with the posterior temporal branch. It appears above the upper margin of the external pterygoid muscle and runs horizontally laterally behind the insertion of the temporal muscle to reach the deep surface of the masseter. The **buccal** nerve is the largest and most distinct branch of the anterior division (Fig. 30). It appears from between the two heads of the external pterygoid muscle and runs downwards and forwards to the surface of the buccinator muscle, where it unites with branches of the facial nerve to form the buccal plexus. From the plexus it is distributed to the mucous membrane and the skin of the cheek. In its course forwards it often pierces the anterior fibres of the temporal

muscle, to which it may give off a small branch (Fig. 30). The nerve to the **external pterygoid** arises, as a rule, with the buccal nerve and passes between the two heads of the muscle giving a branch to each.

The **posterior division** is almost entirely a sensory nerve, and is distributed in three large branches, the **auriculo-temporal**, the

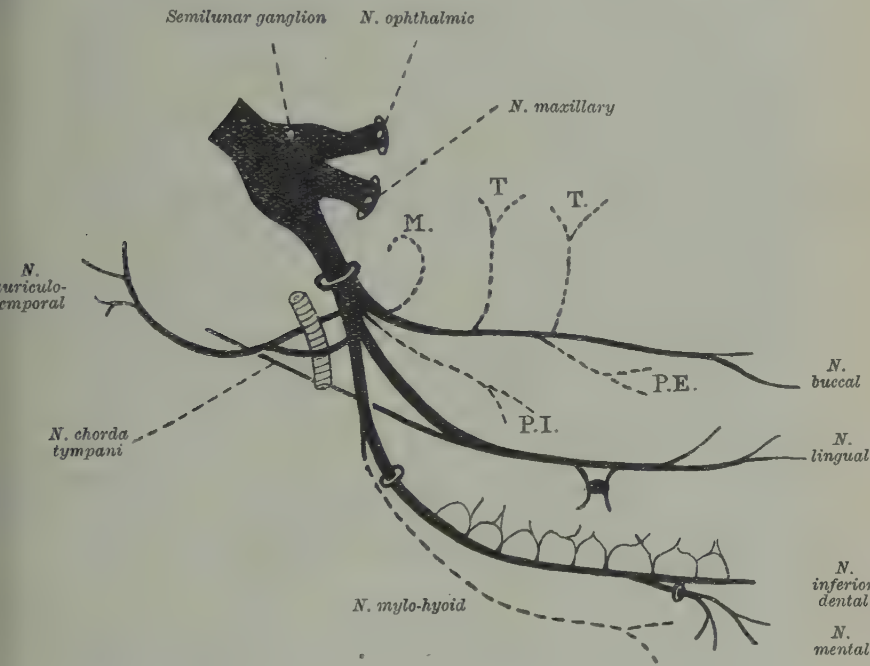


Fig. 33.

*A scheme of the mandibular nerve and its branches.* The motor branches are in broken lines and the sensory branches in solid lines. The middle meningeal artery and the submaxillary ganglion are shown.

T. Deep temporal. M. Masseteric. P.I. Nerve to internal pterygoid, and P.E. Nerve to external pterygoid muscle.

**inferior dental**, and the **lingual** nerves, into which it divides close to the base of the skull. The few motor fibres it contains are continued into the inferior dental branch, which they leave, however, as this nerve enters the dental canal as the **mylo-hyoid** nerve. The auriculo-temporal nerve will require to be carefully dissected out from the tough fibrous tissue on the deep surface of the jaw joint, but the others are easily defined; and joining the upper part of

the lingual nerve from behind there can readily be found the **chorda tympani** branch of the facial nerve.

The **auriculo-temporal** nerve arises by two roots though sometimes the deeper of them is absent. These embrace the middle meningeal artery and unite behind it to form the stem of the nerve. This runs backwards beneath the external pterygoid muscle and passes between the neck of the mandible and the spheno-mandibular ligament. It then turns upwards in front of the ear under cover of the parotid gland, to which it gives off twigs; and having crossed the zygoma with the superficial temporal artery, it breaks into its terminal branches in the temporal region of the scalp. In its course in front of the ear, it gives off branches to it which supply its upper and anterior part and the skin lining the external meatus.

The **inferior dental** nerve, having emerged from under cover of the lower border of the external pterygoid muscle, descends between the ramus of the jaw and the spheno-mandibular ligament to the dental foramen. It enters the dental canal in company with the inferior dental artery, which lies behind it, but before it enters it gives off the slender **mylo-hyoid** nerve (Fig. 33). This branch, accompanied by the artery of the same name, pierces the spheno-mandibular ligament, and runs downwards and forwards in a groove on the deep surface of the mandible. It has already been dissected in the digastric triangle of the neck, where it supplies the anterior belly of the digastric and the mylo-hyoid muscle.

The **lingual** nerve is entirely a sensory nerve. Like the inferior dental nerve, which lies behind it, it runs downwards deep to the external pterygoid muscle and appears at its lower border. It then passes downwards and forwards on the surface of the internal pterygoid muscle and deep to the ramus of the jaw, and enters the submaxillary region where it will afterwards be secured and traced to the front part of the tongue. While still deep to the external pterygoid muscle it is joined by the **chorda tympani**, and is usually connected to the inferior dental nerve by a transverse branch.

The **chorda tympani** is a branch of the facial nerve. It is a slender twig but is readily secured. It emerges at the medial end of the petro-tympanic (Glasserian) fissure and runs downwards and forwards, deep to the spheno-mandibular ligament and the inferior dental nerve, and joins the upper part of the lingual nerve at an acute angle (Fig. 33).

The student should now open the inferior dental canal by removing the outer table of the mandible over it with a small saw, the chisel, and the bone forceps. There will be exposed within the canal the **inferior dental vessels** and **nerve**. They give off branches to the posterior teeth and at the mental foramen both the artery and the nerve divide into **mental** and **incisor** branches. The mental branches issue through the mental foramen, and were secured in the dissection of the face (p. 19); the incisor branches continue in the bone to the middle line and send twigs to the canine and the incisor teeth.

## THE SUBMAXILLARY REGION

(The submaxillary region has already been partially dissected as part of the digastric triangle of the neck (p. 63), but it is now necessary to carry the dissection deeper in order to expose the side of the tongue and the floor of the mouth.)

The sterno-mastoid muscle is to be thrown back to its insertion, so that the **digastric** and **stylo-hyoid** muscles are fully exposed (Fig. 23). The attachments of these muscles should be examined.

The **digastric** muscle, as its name implies, consists of two fleshy bellies which are united by an intervening tendon. The **anterior** belly arises from the deep surface of the lower border of the mandible close to the middle line, while the **posterior** belly is attached to the digastric fossa on the medial side of the mastoid process of the temporal bone. The two bellies converge towards the hyoid bone, and just above its upper border are united by the intervening tendon, which is connected to the hyoid bone by a broad band of fibrous tissue ; behind this band the tendon is embraced by the cleft lower end of the stylo-hyoid muscle. The anterior belly is subject to many variations, the most frequent being its subdivision into two parts, the medial of which may cross the middle line. The anterior belly is supplied by the mylo-hyoid branch of the fifth nerve, and the posterior belly by the stylo-hyoid branch of the seventh nerve.

The **stylo-hyoid** is a slender muscle which lies along the upper border of the posterior belly of the digastric. It arises from the back of the middle part of the styloid process and is inserted into the hyoid bone, at the junction of the body and the great cornu, by two slips which embrace the tendon of the digastric muscle. It is supplied by a branch of the facial nerve (p. 84).

The relations of the digastric and stylo-hyoid muscles have been considered in some measure already (p. 63), but it is convenient to revise them in the present dissection (Fig. 23). The anterior belly of the digastric is superficially placed, being covered only by the skin and the fascial tissues, though it is often overlapped from behind by the **submaxillary gland**. Its deep surface is in contact with the **mylo-hyoid** muscle. The posterior belly is covered behind by the sterno-mastoid muscle and in front of this by the angle of the jaw ; and between these two parts it is overlaid by the parotid gland. Beyond the angle of the jaw it is more superficial, being covered by the deep and superficial fasciæ, the platysma muscle, and the skin ; and the anterior facial vein crosses it and it is usually overlapped by the posterior part of the submaxillary gland. Deep to it, and the stylo-hyoid muscle, there should be identified (1) the internal jugular vein, and the internal and external carotid arteries ; (2) the facial artery, and the

occipital and posterior auricular arteries which pass backwards under cover, respectively, of its lower and upper borders; (3) the hypoglossal nerve which descends vertically in the interval between the internal jugular vein and the internal carotid artery, and the accessory nerve which passes backwards between it and the internal jugular vein; and (4) the posterior part of the **hyoglossus muscle.**

The facial artery and the anterior facial vein are to be divided as they cross the mandible, and the anterior belly of the digastric muscle is to be detached from the lower border of the bone. The mandible is then to be sawn through on either side of the middle line, the two incisions to be made about half an inch apart; care must be specially taken not to divide the mylo-hyoid muscles or the mucous membrane of the floor of the mouth. The lateral parts of the mandible can now be everted and are to be fixed in this position with hooks. The whole surface of the **mylo-hyoid** muscle is to be exposed by turning the submaxillary gland backwards, and on it there are to be found again the **mylo-hyoid nerve** and **artery** as well as the **submental** branch of the facial artery. As the submaxillary gland is turned backwards, it should be noted that a process from it passes anteriorly under the posterior border of the mylo-hyoid muscle; this is the **deep part** of the gland and from it the **submaxillary duct** is continued forwards on the floor of the mouth. The attachments of the mylo-hyoid muscle are to be examined.

The **mylo-hyoid** is a thin sheet of muscle which arises from the mylo-hyoid ridge on the deep surface of the mandible, extending from the last molar tooth almost to the middle line in front. Its fibres run towards the middle line and a little downwards and backwards, parallel to one another. The posterior fibres are inserted into the body of the hyoid bone, but the larger number, becoming shorter as they are placed further forwards, end in a median tendinous raphe which extends from the symphysis of the jaw to the hyoid bone. The posterior border alone is free. The two muscles together form the floor of the anterior part of the mouth (Fig. 35). The mylo-hyoid branch of the inferior dental nerve has already been traced to the muscle.

The **submaxillary gland** consists of two portions, a larger superficial portion and a smaller deep portion, which are continuous with one another round the posterior edge of the mylo-hyoid muscle; this muscle, therefore, intervenes between the two parts. The superficial portion is to be examined. It fills the interval between the two bellies of the digastric muscle, overlapping both of them, and is enclosed in a sheath of deep cervical fascia (p. 60).

The **superficial** portion of the **submaxillary gland** rests on the mylo-hyoid muscle in front and on the hyoglossus muscle behind, and there covers the lingual and the hypoglossal nerves. It extends upwards under cover of the lower jaw as high as the mylo-hyoid ridge, and is related there to the mylo-hyoid artery and nerve. Below the jaw it is covered by the deep and superficial fasciæ and the skin, and is crossed by the anterior facial vein and the cervical branches of the facial nerve. Along the upper border of this part lie the majority of the submaxillary lymph glands. Its posterior end lies against the stylo-mandibular ligament which separates it from the parotid gland and it is cleft by a groove which holds the facial artery, from which its blood supply is derived.

The mylo-hyoid muscle is to be detached from the lower jaw and turned forwards, care being taken not to cut the mucous membrane of the mouth which is in contact with it above. The side of the **tongue**, below the level of the mucous membrane which stretches from it across the floor of the mouth to the gum of the lower jaw, is now brought into view.

The **tongue** is essentially a muscular organ which is attached posteriorly to the hyoid bone and inferiorly to the mandible; and in the mucous membrane which covers its upper surface there is lodged a large number of "taste buds," the minute peripheral organs of taste. The musculature of the tongue comprises two groups of fibres; namely (1) those which lie entirely within itself, the **intrinsic** muscles, and (2) those which arise from parts without the tongue and are inserted into it, the **extrinsic** muscles. It is the extrinsic muscles alone which are to be examined in the present dissection; and with them there fall to be studied the **nerves** and the **vessels** of the **tongue**.

The extrinsic muscles are well exposed and are readily identified (Fig. 34). The **hyoglossus** is a flat, quadrangular muscle which extends from the hyoid bone to the side of the tongue; its anterior and posterior borders should be defined, the latter by displacing backwards the stylo-hyoid and the posterior belly of the digastric muscle. In front of it lie the **genio-hyoid** and **genio-glossus** muscles, the former superficial to the latter; while mingling with the fibres of the upper part of its posterior border is the **stylo-glossus** muscle. On the surface of the hyoglossus there should be recognised (Fig. 34), (1) the **hypoglossal nerve**, and accompanied by the **lingual veins**; (2) the **lingual nerve** which lies on the muscle near its insertion into the tongue; and (3) between the two nerves the **deep** part of the **submaxillary gland** and the **duct** which arises from it (Fig. 34). Anterior to the hyoglossus muscle, and resting on the genio-glossus muscle, there will be seen the

**sublingual gland**; the lingual nerve and the duct of the submaxillary gland pass forwards deep to it. The connections of some of the muscles should now be examined.

The **hyoglossus** (Fig. 34) is a flat, quadrate muscle which arises from the whole length of the great cornu and from the lateral part of the body of the hyoid bone. Its fibres pass upwards to the posterior half of the side of the tongue, and from there they spread forwards and inwards into its substance. (There is often an accession of fibres to the deep

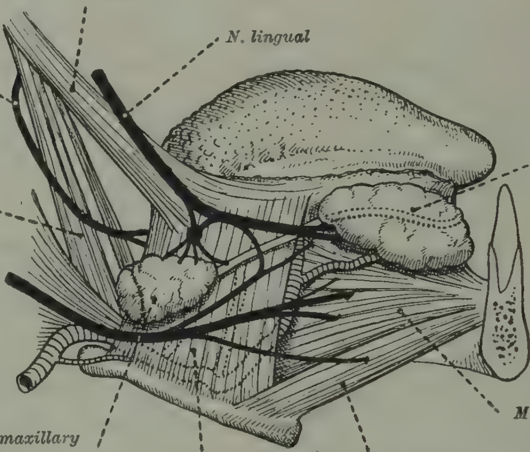


FIG. 34.

*Dissection of the submaxillary region.* Attached to the lingual nerve is the submaxillary ganglion, and passing under it from the deep part of the gland is the submaxillary duct. The lingual artery should be coloured and its branches named.

surface of the muscle from the lesser cornu of the hyoid bone; they form the chondro-glossus muscle. The lingual artery intervenes between it and the hyoglossus.)

The **stylo-glossus** muscle (Fig. 34) is a slender, fleshy slip which arises from the front of the styloid process near its tip and from the stylo-mandibular ligament, to which, indeed, the greater number of its fibres are sometimes attached. It passes forwards and downwards and is inserted on the side of the tongue as far as its tip, its fibres decussating and blending with those of the hyoglossus.

The **genio-hyoid** muscle (Fig. 34) does not belong to the tongue; it is a suprahyoid muscle and an elevator of the hyoid bone. It is a short, narrow muscle which lies close to the middle line and in contact with its fellow of the opposite side. Its origin is from the lower mental spine on the deep surface of the symphysis of the jaw and it is inserted on the

anterior surface of the body of the hyoid bone. It is supplied by a branch given off from the hypoglossal nerve, but which consists of fibres derived from the upper cervical nerves (Fig. 26).

The **hypoglossal nerve** was traced in the dissection of the anterior triangle as far as the posterior border of the mylo-hyoid muscle (p. 64). It is now seen passing forwards on the hyoglossus muscle close to the hyoid bone (Fig. 34). At the anterior border of the hyoglossus it gains the surface of the genio-glossus muscle, into the substance of which it sinks and breaks into branches which supply it and the intrinsic muscles of the tongue. In addition to supplying these muscles, it gives off branches to the stylo-glossus, hyoglossus, and genio-hyoid muscles, and communicates with the lingual nerve by one or more loops. The hypoglossal nerve may now be defined as the motor nerve to the intrinsic and extrinsic muscles of the tongue; and, through the communications it forms with the upper cervical nerves (Fig. 26), it carries fibres which are distributed from it to the genio-hyoid and to the infra-hyoid muscles.

The **lingual nerve** is to be cleaned, and by dissecting carefully in the interval between it and the deep part of the submaxillary gland, the minute **submaxillary ganglion is** to be exposed; it is suspended from it by two branches. The **deep** part of the **submaxillary gland** and the **sublingual gland** are to be examined.

The **deep** part of the **submaxillary gland** (Fig. 34) is much smaller than the superficial part, with which it is continuous at the posterior border of the mylo-hyoid muscle. It extends forwards on the hyoglossus muscle, lying below the mucous membrane of the mouth; its anterior extremity usually reaches the hinder end of the sublingual gland. The **duct** of the gland (Wharton's duct) commences in the superficial part and runs forwards with the deep part between the hyoglossus and mylo-hyoid muscles. It lies above the hypoglossal nerve and at first below the lingual nerve, but afterwards passes beneath it and lies at a higher level. It then passes on to the genio-glossus muscle deep to the sublingual gland, and opens on the floor of the mouth beneath the tongue on a summit of a small papilla close to the middle line (p. 171).

The **sublingual gland** (Fig. 34) is the smallest of the three salivary glands. It lies beneath the mucous membrane on the floor of the mouth at the side of the tongue, and can be recognised there by the fold it produces, the plica sublingualis. Its deep surface rests on the genio-glossus muscle and on the submaxillary duct and the lingual nerve, while its superficial surface is lodged in the sublingual depression on the deep surface of the mandible above the mylo-hyoid ridge. The mylo-hyoid muscle supports it below (Fig. 35). The gland is almond-shaped and about an inch long. Its anterior end reaches the middle line and is in contact with the gland of the opposite side. The ducts of the gland (ducts of Rivini) are from eight to twenty in number; they open into the mouth along the sublingual fold (plica sublingualis).

The **lingual nerve** (Fig. 34) has already been followed from its origin from the mandibular nerve on to the surface of the internal pterygoid muscle deep to the ramus of the jaw (Fig. 30). It then runs forwards between the jaw and the mucous membrane of the mouth below the last molar tooth, and having crossed the stylo-glossus, reaches the surface of the hyoglossus muscle. It communicates there by one or more loops with the hypoglossal nerve, and having crossed the submaxillary duct,

passes beneath the sublingual gland and breaks into its terminal branches. These pierce the substance of the tongue and supply the mucous membrane over its anterior two-thirds; other branches supply the sublingual gland and the mucous membrane of the floor of the mouth.

The **submaxillary ganglion** (Fig. 34) is of small size, not larger than the head of a pin, and is suspended from the lingual nerve by two short branches. The posterior of these, often in the form of two or three

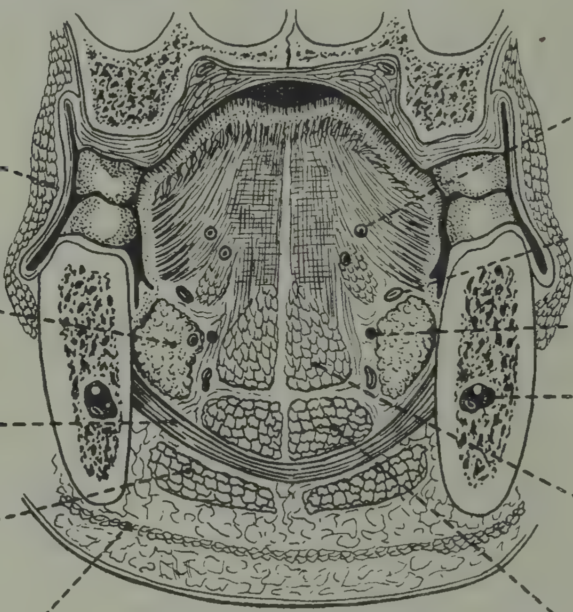


FIG. 35.

*Vertical transverse section through the mouth.* The relations of the muscles forming the floor of the mouth and of the sublingual gland are to be carefully studied.

filaments, conveys into the ganglion fibres from the chorda tympani nerve; the anterior branch, on the other hand, consists of fibres which pass from the ganglion to the lingual nerve and are distributed to the sublingual gland. Sympathetic fibres from the plexus round the facial artery also enter the ganglion. The ganglion gives off branches to the submaxillary gland as well as those which pass to the sublingual gland. It must be looked on, therefore, as the origin of the secretory fibres to those glands, and to be connected to the central nervous system by two paths, namely, the chorda tympani branch of the facial nerve and the sympathetic fibres round the facial artery. The **chorda tympani** fibres do not all pass to the submaxillary ganglion; most of them are prolonged to the tongue in the lingual nerve.

The hyoglossus muscle is to be separated from the hyoid bone and reflected upwards towards the tongue, so that the structures which lie deep to it may be examined. These structures are (1) the **lingual artery** and its branches and the accompanying **veins**, which are to be cleaned; (2) the posterior part of the **genio-glossus** muscle, the insertion of which is to be exposed by removing the necessary amount of mucous membrane from the tongue; and (3) the attachment of the **stylo-hyoid ligament** to the lesser cornu of the hyoid bone.

The **genio-glossus** is a flat, fan-shaped muscle, placed vertically and in contact with its fellow in the median plane (Fig. 61). It arises by a short tendon from the upper mental spine on the deep surface of the symphysis of the mandible, and from there its fibres spread out widely. The lowest fibres are inserted into the hyoid bone and a few into the side of the pharynx, but the great bulk of them pass into the substance of the tongue in which they extend from the tip to the base.

The **lingual artery** has already been seen to arise from the external carotid artery and to pass medially to the posterior border of the hyoglossus muscle (p. 65). It then proceeds forwards above the great cornu of the hyoid bone, resting on the **middle constrictor** muscle of the **pharynx** and on the genio-glossus and under cover of the hyoglossus, which separates it from the hypoglossal nerve (Fig. 34). In this part of its course it gives off its **dorsales linguæ** branches, and at the anterior border of the hyoglossus it divides into its two terminal branches, the **ranine and sublingual arteries** (Fig. 34).

The **dorsales linguæ** are generally two definite branches which ascend under the hyoglossus muscle to the back part of the tongue, and supply the muscular tissue and the mucous membrane. A few twigs are also given to the tonsil and to the pillars of the fauces. The **sublingual** artery, generally of good size, runs forwards and upwards between the genio-glossus muscle and the sublingual gland, both of which it supplies. It gives branches also to the mucous membrane of the mouth and to the gum and anastomoses with its fellow of the opposite side. The **ranine** artery, or deep artery of the tongue, at first ascends almost vertically on the genio-glossus and then runs forwards on the under surface of the tongue to its tip. It can be easily exposed by reflecting the mucous membrane which covers it. The course of the vessel is tortuous, but it should be noted that the curves disappear when the tongue is stretched. There is little anastomoses between the two arteries across the middle line, so that the tongue may be split in the medial plane without much bleeding taking place.

Two small **lingual veins** accompany the lingual artery, but the main lingual vein accompanies the hypoglossal nerve on the surface of the hyoglossus muscle. These veins all unite to form the lingual vein which opens into the common facial vein or into the internal jugular vein (p. 63).

The **stylo-hyoid ligament** should also be examined in this dissection. It is a narrow, fibrous cord which is attached to the tip of the styloid process and extends downwards and forwards to the lesser cornu of the hyoid bone under cover of the hyoglossus. It is often ossified in a considerable part of its length.

The sensory nerve to the posterior part of the tongue, the **glosso-pharyngeal** (ninth cranial) **nerve**, should now be secured as it emerges from between the internal jugular vein and the internal carotid artery behind the **stylo-pharyngeus** muscle (Fig. 60). This is the most posterior of the three styloid muscles, and it descends to the lowest level; the stylo-hyoid should be retracted well backwards to expose it. The glosso-pharyngeal nerve winds over its lateral surface and passes beneath the upper part of the posterior border of the hyoglossus muscle (Fig. 60), and, since that muscle is reflected, the nerve can be followed in its course upwards beneath the stylo-glossus muscle to the back part of the tongue, of which it supplies the mucous membrane covering the side and the dorsal surface. It will be seen again in a later dissection.

A short return should be made at this stage of the dissection to the pterygoid region, to display there a small ganglion, similar in nature to the submaxillary ganglion, and named the **otic ganglion**. The lingual and the inferior dental nerves should be divided a short distance below their origin, so that the upper part of the mandibular nerve, now freed, can be everted. The muscle fibres which are exposed, and on which the middle meningeal artery rests, are those of the **tensor palati** (Fig. 60); and lying on them, deep to the mandibular nerve, immediately below the foramen ovale, and in front of the middle meningeal artery, the otic ganglion should be secured.

The **otic ganglion** is a small pinkish body about one-eighth of an inch in length, lying in the position described above. It is closely related with the nerve to the internal pterygoid muscle from which it receives some fibres; and in addition there enter it (1) sympathetic fibres from the plexus round the middle meningeal artery, and (2) the small superficial petrosal nerve which connects it to the facial and glosso-pharyngeal nerves (p. 159). It gives off (1) branches to the tensor palati muscle; (2) a branch to the tensor tympani muscle of the middle ear; (3) a communicating branch to the chorda tympani; and (4) twigs to both roots of the auriculo-temporal nerve, which are carried in it to the parotid gland (p. 96).

## THE GREAT VESSELS AND NERVES OF THE NECK

The student must now return to the dissection of the neck to examine there the upper parts of the great vessels and the course and distribution of the last four cerebral nerves.

The **external carotid artery** should be examined first. It is exposed now in the whole of its course, from its origin at the bifurcation of the common carotid artery at the level of the upper border of the thyreoid cartilage to its termination in the parotid gland; and its branches have all been examined in at least parts of their course. The vessel is accompanied by a large sympathetic plexus derived from the superior cervical ganglion, and all the branches of the artery carry offshoots from it.

The **external carotid artery** lies at first on the medial side of the internal carotid artery, but as it ascends this vessel passes to a position posterior and medial to it. At its commencement and while it lies in the carotid triangle, the external carotid artery is comparatively superficial. It is covered there by the skin, the superficial fascia with the platysma muscle, the transverse cervical nerve and the cervical branches of the facial nerve, and the deep fascia; and deep to this fascia it is crossed by the common facial and lingual veins and the hypoglossal nerve (Fig. 23). It then passes under cover of the lower end of the parotid gland and is crossed from behind forwards by the anterior branch of the posterior facial vein and the posterior belly of the digastric and the stylo-hyoid muscle. At its termination it lies deeply in the parotid gland behind the neck of the mandible and is crossed by the branches of the facial nerve (Fig. 28).

The muscular wall of the pharynx lies in contact with the medial side of the artery at its commencement, and the internal and external laryngeal nerves are also to be found there. The medial relations at a higher level are the structures which intervene between it and the internal carotid artery, namely, the stylo-pharyngeus muscle, the tip of the styloid process and the stylo-hyoid ligament, the stylo-glossus muscle, the pharyngeal branch of the vagus and the glosso-pharyngeal nerve (Fig. 37).

The external carotid artery diminishes rapidly in size owing to the number of large branches given off from it. These branches are, the **superior thyreoid**, the **lingual**, and the **facial** arteries which arise from its anterior aspect; the **occipital** and the **posterior auricular** vessels which are given off from behind; the **ascending pharyngeal** which springs from the medial side; and the **superficial temporal** and the **internal maxillary** arteries which are its terminal branches (Fig. 36). They have already been examined in great part, but all of them should be reviewed at the present time.

The **superior thyreoid artery** arises from the external carotid artery close to its commencement. It lies there at the anterior border of the

sterno-mastoid muscle and could be reached easily from the surface. It arches downwards and forwards lying superficial to the external laryngeal nerve, and passes below the omo-hyoid, sterno-hyoid, and sterno-thyreoid muscles to the apex of the lateral lobe of the thyreoid gland to which it distributes its terminal branches, principally on the anterior surface. In its course it gives off the following branches: (1) The **hyoid** artery, a small vessel which runs along the lower border of the hyoid bone beneath the thyreo-hyoid muscle and anastomoses with the vessel of the opposite side. (2) The **superior laryngeal** artery accompanies the nerve

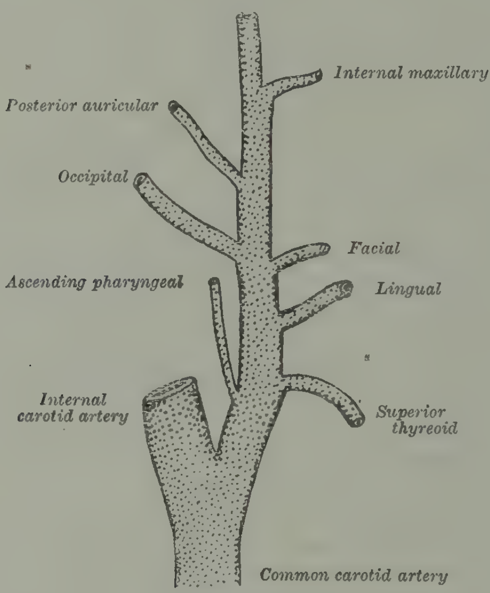


Fig. 36.

*Diagram of the branches of the external carotid artery.*

of that name, and having pierced the thyreo-hyoid membrane supplies the muscles and the mucous membrane of the larynx. (3) The **sterno-mastoid** branch runs downwards and laterally across the common carotid artery and sinks into the deep surface of the muscle. Frequently it is a separate branch of the external carotid trunk. (4) The **crico-thyreoid** artery runs transversely across the upper part of the crico-thyreoid membrane and communicates with the artery of the opposite side.

The **superior thyreoid vein** begins in a plexus on the surface of the thyreoid gland and receives branches corresponding more or less to the branches of the artery. It crosses the upper part of the common carotid artery and opens into the internal jugular vein (Fig. 23).

The **lingual artery** is the artery which supplies the tongue. It arises

at the level of the great cornu of the hyoid bone, and its course may be divided into two parts: (1) in the carotid triangle where it is comparatively superficial (p. 65); and (2) in the submaxillary region where it lies deep to the hyoglossus muscle (p. 103).

The **facial artery** arises in the upper part of the carotid triangle close above the lingual artery. It passes upwards on the surface of the middle constrictor of the pharynx and disappears beneath the posterior belly of the digastric and the stylo-hyoid muscle. At the upper border of the stylo-hyoid it enters a deep groove on the posterior end of the submaxillary gland; and after emerging from this it bends downwards and turns round the lower border of the mandible at the anterior edge of the masseter muscle and passes on to the face (p. 17). In the cervical part of its course it gives off: (1) The **ascending palatine** artery which runs between the stylo-pharyngeus and stylo-glossus muscles to the soft palate. (2) The **tonsillar** branch which runs between the internal pterygoid and stylo-pharyngeus muscles (see Fig. 28) and then along the side of the pharynx; it pierces the superior constrictor and ends in the tonsil. (3) **Branches** to the **submaxillary** gland. (4) The **submental** artery, a branch of some size, arises close to the lower border of the mandible and runs forwards on the mylo-hyoid muscle. At the chin it turns over the margin of the jaw and ends in branches to the muscles and the skin.

The **facial vein** crosses the margin of the jaw posterior to the artery and has been traced downwards and backwards superficial to the submaxillary gland. It joins the anterior branch of the posterior facial vein to form the common facial vein, which enters the internal jugular vein at the level of the hyoid bone (Fig. 23).

The **occipital artery** arises opposite the facial artery and close to the lower border of the posterior belly of the digastric muscle; the hypoglossal nerve hooks round it at this point. It runs upwards and backwards under cover of the digastric muscle to the deep surface of the mastoid process, crossing the internal carotid artery, the internal jugular vein, and the accessory nerve in its course. From the mastoid process it crosses the upper part of the back of the neck and enters the scalp (p. 25). It gives off: (1) **muscular** branches, that to the **sterno-mastoid** accompanying the accessory nerve and sinking with it into the muscle; and (2) a small **meningeal** branch which runs with the internal jugular vein through the jugular canal.

The **posterior auricular artery**, smaller than the occipital, arises from the external carotid above the digastric and stylo-hyoid muscles. It is, therefore, deeply placed at its commencement, and runs upwards and backwards between the styloid process and the deep part of the parotid gland to reach the groove between the cartilage of the auricle and the mastoid process. There it associates itself with the posterior auricular nerve and is distributed to the scalp (p. 25). In addition to its terminal branches it gives off (1) twigs to the **parotid** gland; (2) the **stylo-mastoid** artery which enters the stylo-mastoid foramen and in the interior of the temporal bone supplies the tympanic cavity and the mastoid air cells.

The **superficial temporal** and **internal maxillary arteries** commence at the bifurcation of the external carotid at the level of the neck of the mandible. Both have already been described in full (pp. 25 and 90).

The **ascending pharyngeal** artery and the upper parts of the **internal carotid artery** and the **internal jugular vein** will only be fully exposed after the styloid muscles have been reflected from

them. In order to gain free access to the deep parts, the posterior belly of the digastric should be divided close to its origin and the external carotid artery cut across below the origin of its facial branch; and both of these structures being displaced, the **stylo-pharyngeus** muscle can be examined, care being taken of the **glosso-pharyngeal nerve** as it lies on its surface.

The **stylo-pharyngeus** (Fig. 60) is larger and longer than the other styloid muscles, and often it consists of two parts. It arises from the medial surface of the styloid process close to its root and proceeds downwards and forwards to the side of the pharynx, where it passes under cover of the upper border of the middle constrictor muscle. It broadens considerably in the pharyngeal wall, in which some of its fibres end; but, after being joined by the palato-pharyngeus, the greater part is inserted on the posterior border of the thyreoid cartilage (p. 178).

The base of the styloid process is to be snipped through with the bone forceps and, with the muscles attached to it, it is to be turned downwards. The **ascending pharyngeal** artery should then be found on the wall of the pharynx in the interval between the external and internal carotid arteries and followed upwards to the base of the skull.

The **ascending pharyngeal** artery is a long slender vessel which arises from the medial side of the external carotid artery close to its lower end. It ascends vertically on the wall of the pharynx deep to the stylo-pharyngeus muscle, at first in the interval between the external and internal carotid arteries and then on the medial side of the internal vessel. It gives off (1) **pharyngeal** branches, which supply the muscles and the mucous membrane of the pharynx; (2) a **palatine** branch which is distributed to the soft palate; and (3) **muscular** branches to the prevertebral muscles. At the base of the skull it gives off several small **meningeal** branches, which enter the skull through the foramen lacerum, the jugular foramen, and sometimes through the anterior condyloid foramen along the hypoglossal nerve.

The dissection of the external carotid artery and its branches now being completed, the student should consider the parts which are supplied by them. They are:—

1. The superficial parts of the face and the scalp.
2. The mouth and the structures belonging to it, the salivary glands, the tongue, the teeth, and the palate.
3. The viscera of the upper part of the neck, the pharynx and larynx, the upper parts of the œsophagus and trachea, and the thyreoid gland; the tympanic cavity, the Eustachian tube, and the external ear; and the muscles of the front of the neck.
4. The dura mater of the brain by the various meningeal branches.

The **internal carotid** artery is now to be dissected. It commences at the bifurcation of the common carotid artery and ascends vertically through the neck to the base of the skull. There it enters the carotid canal of the temporal bone and, passing through it, reaches the interior of the cranium; and it is

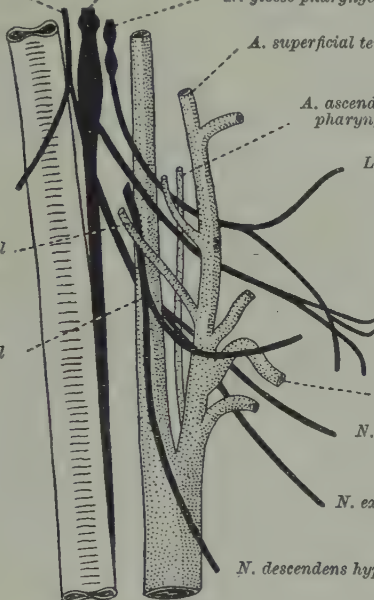


FIG. 37.

*A scheme of the relations of the great vessels of the neck and the last four cerebral nerves.*

expended there in the supply of the cerebral hemisphere, the eye and its appendages, and the nose, only a few small branches becoming superficial over the lower part of the forehead. The cervical part alone comes under notice in the present dissection. It requires to be carefully cleaned at its upper part where it is invested by a tough fascia, for in this tissue the last four **cerebral nerves** and the upper part of the **cervical sympathetic trunk** are embedded. The **pharyngeal branch** of the **vagus** which runs downwards and forwards across the surface of the artery should be

secured at once, and then the **glosso-pharyngeal** trunk at a higher level. The external and internal laryngeal nerves, when followed upwards, will be found to arise from one stem, the **superior laryngeal** branch of the **vagus**, which passes forwards deep to the internal carotid artery (Fig. 37). The trunks of the last four cerebral nerves, the **glosso-pharyngeal**, **vagus**, **accessory**, and **hypoglossal** nerves, are then to be followed to the base of the skull, where they lie close together in the interval between the internal jugular vein and the internal carotid artery (Fig. 37).

The **internal carotid artery** lies at first in the carotid triangle and is comparatively superficial, being covered only by the integument and the fasciæ and overlapped by the sterno-mastoid muscle. More intimately, however, it is also overlapped by the anterior border of the internal jugular vein, while the descendens hypoglossi runs downwards on its surface; and it is crossed by the hypoglossal nerve and the common facial and lingual veins (Fig. 38). At a higher level it lies much more deeply, for as it ascends it passes under the lower end of the parotid gland (Fig. 28) and is crossed by the posterior belly of the digastric and the stylo-hyoid muscle and the occipital and posterior auricular arteries which accompany them; and in addition to these structures it is covered by those which intervene between it and the external carotid artery, namely, the pharyngeal branch of the vagus, the stylo-pharyngeus muscle, the glosso-pharyngeal nerve and the styloid process (Fig. 37). Posteriorly the artery rests on the longus capitis muscle in front of the upper three cervical vertebræ. The cervical sympathetic trunk descends behind it and the superior laryngeal nerve runs medially posterior to it. On its medial side, closer to it below than above, lies the wall of the pharynx and the ascending pharyngeal artery, while on its lateral side below, but inclining posteriorly as it ascends, is the internal jugular vein. At the base of the skull the last four cerebral nerves emerge between it and the vein; the accessory nerve, however, soon passes backwards, the glosso-pharyngeal and the hypoglossal nerves run forwards, while the vagus descends behind its lateral margin.

The internal carotid artery gives off no branches in the neck.

The **internal jugular vein** collects the blood from the brain, from the superficial parts of the face, and from the neck. The right vein is usually larger than the left. It commences at the base of the skull where it is directly continuous with the lateral sinus of the cranial cavity through the posterior compartment of the jugular foramen. At its commencement it is somewhat dilated, the dilatation being called "the bulb." The lumen of the bulb remains constantly patent owing to the connection of its walls to the margins of the foramen; this is in marked contrast to the rest of the vein which collapses and dilates during the respiratory cycle. From its origin the internal jugular vein runs down the neck on the lateral side, first, of the internal carotid artery and then of the common carotid artery (Fig. 38); and at the root of

the neck, behind the medial end of the clavicle, it unites with the subclavian vein to form the innominate vein (Fig. 22). At or near its termination there is a venous valve which should be examined by slitting open the lower end of the vein. The tributaries of the vein are, the **inferior petrosal sinus** which joins it just below its bulb, and then, successively, the **common facial vein**, the **lingual vein**, and the **superior** and **middle thyreoid veins** (Fig. 38).

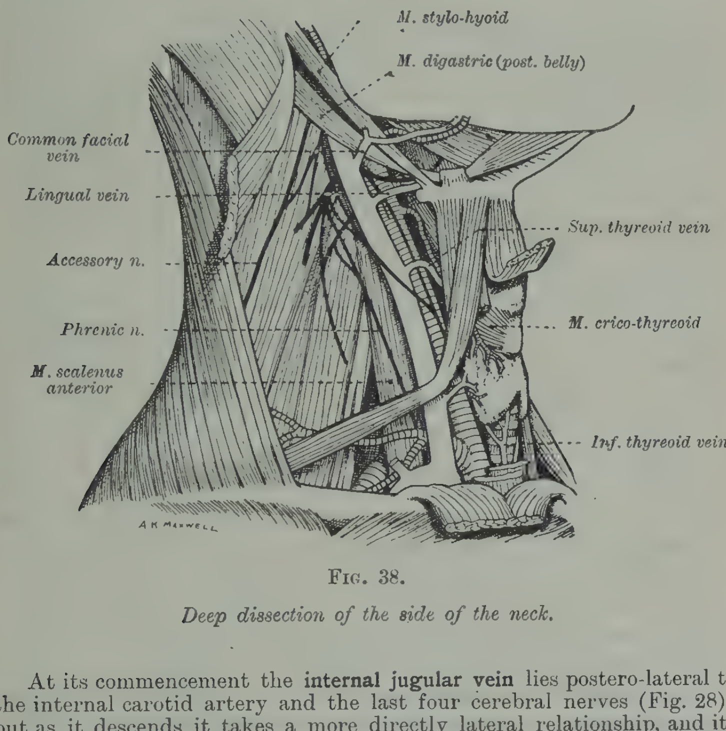


Fig. 38.

*Deep dissection of the side of the neck.*

At its commencement the **internal jugular vein** lies postero-lateral to the internal carotid artery and the last four cerebral nerves (Fig. 28); but as it descends it takes a more directly lateral relationship, and its anterior margin even overlaps to a slight extent, first, the internal and then the common carotid artery. At the root of the neck, however, the right vein lies a little distance from the carotid artery, but on the left side it continues to overlap it. The relations of the internal jugular vein are very much the same as those of the internal carotid artery above and the common carotid artery below, with which and the vagus nerve it is enclosed in the carotid sheath. Most of the following details, therefore, are but a repetition of the relations of those vessels.

At its upper part, the vein lies deep to the styloid process and the stylo-pharyngeus and stylo-hyoid muscles and then is crossed by the posterior belly of the digastric muscle, along the upper and lower borders of which the posterior auricular and occipital arteries, respectively, run

backwards; and the accessory nerve, running downwards and backwards, passes superficial (occasionally deep) to it at the level of the transverse process of the atlas. The glosso-pharyngeal and the hypoglossal nerves pass forwards between the vein and the internal carotid artery. At a lower level the vein is covered by the lower end of the parotid gland, but after emerging from it, it lies under cover of the anterior border of the sterno-mastoid muscle, though it may project in front of the muscle in the upper part of the carotid triangle (Fig. 38). The surface of the vein is intimately related to the deep cervical lymph glands, which lie for the most part on its lateral side and between it and the sterno-mastoid muscle; and under cover of the muscle it is crossed by the communicans hypoglossi from the cervical plexus, the sterno-mastoid branch of the superior thyreoid artery, and the omo-hyoid muscle.

Posteriorly the vein rests on the rectus capitis lateralis muscle and the loop between the first and second cervical nerves. Below the atlas it rests on the transverse processes of the cervical vertebræ between the scalenus anterior laterally and the longus capitis medially. The ascending cervical artery and the phrenic nerve lie behind it, and crossing the nerve there are the transverse cervical and suprascapular arteries. On the left side the thoracic duct also lies posterior to it. At the root of the neck the internal jugular vein crosses the first part of the subclavian artery and joins the subclavian vein.

The last four cerebral nerves emerge from the cranial cavity at the base of the skull and pass through the upper part of the neck to their distribution. The **glosso-pharyngeal, vagus,** and **accessory** nerves emerge through the jugular foramen in that order from before backwards, and lie between the internal carotid artery in front and the internal jugular vein behind; and the **hypoglossal** nerve, having emerged through the anterior condyloid foramen, associates itself with them. The nerves retain their common intermediate relationship to the vessels only for a short distance, and then each pursues its own course (Fig. 37). The glosso-pharyngeal nerve passes forwards superficial to the internal carotid artery to be distributed to the tongue and the pharynx; the accessory nerve passes backwards superficial (or deep) to the internal jugular vein to the sterno-mastoid and trapezius muscles; the hypoglossal nerve runs forwards across the internal and external carotid arteries to be distributed to the muscles of the tongue; and the vagus proceeds vertically downwards in the carotid sheath. The course, relations, and distribution of each of these nerves have now to be studied in detail; but in an ordinary dissection it is impossible to follow out many of their smaller branches. It is those branches, therefore, which the student can dissect for himself that are described in detail below; the others are only mentioned.

The **glosso-pharyngeal** (ninth cranial) **nerve** contains both motor and sensory fibres and, as its name implies, it is distributed to the tongue

and the pharynx. Just beyond its exit from the skull, through the jugular foramen, it passes forwards between the internal jugular vein and the internal carotid artery and descends in front of the latter vessel beneath the styloid process and the muscles attached to it. At the lower border of the stylo-pharyngeus muscle it turns on to its superficial surface and proceeds forwards on the middle constrictor muscle of the pharynx and then under the hyoglossus to the base of the tongue (Fig. 60). It terminates there in its **lingual branches** which supply the mucous membrane of the posterior third of the tongue as a nerve of taste and of common sensibility. The branches which arise from it in the neck are (1) the nerve to the stylo-pharyngeus ; (2) the **pharyngeal branches** which pass to the surface of the medial constrictor of the pharynx with the pharyngeal branch of the vagus, and unites there with it and with the pharyngeal branches of the cervical sympathetic trunk to form the pharyngeal plexus. Branches from the plexus supply the muscular wall of the pharynx and its mucous membrane ; (3) **tonsillar branches** form a plexus over the tonsil from which twigs pass to the mucous membrane of the neighbourhood.

(The student will not be able to dissect the two ganglia which are present on the trunk of the nerve at the lower margin of the jugular foramen, nor the communicating branch to the facial nerve, nor the tympanic branch (Jacobson's nerve) which arises from the lower of them. This nerve passes into the tympanic cavity and takes part in the formation of the tympanic plexus, from which its fibres, or some of them, emerge as the small superficial petrosal nerve. This nerve has already been stated to join the otic ganglion (p. 104).

The **accessory** (eleventh cranial) **nerve** is formed of two parts, a spinal and a cerebral, as will be seen when the brain is removed. The two parts pass through the jugular foramen as one trunk, but just below the base of the skull they again become separate. The cerebral part joins the vagus nerve and is distributed through its branches, contributing the motor fibres to the pharyngeal, superior laryngeal, and recurrent laryngeal nerves. The spinal part passes backwards across (or sometimes deep to) the internal jugular vein and emerges from below the posterior belly of the digastric muscle to reach the sterno-mastoid muscle which it supplies (Fig. 38). It pierces the sterno-mastoid and appears at its posterior border in the posterior triangle of the neck, across which it runs to end in the trapezius muscle (Fig. 21).

The **vagus** (tenth cranial) **nerve** passes through the jugular foramen in company with, and in the same sheath of dura mater as, the accessory nerve. It then runs vertically down the neck in the carotid sheath lying behind and between, first, the internal carotid artery and the internal jugular vein, and then between the common carotid artery and the same vein. Its relations, therefore, are very similar to those of the vessels. At the root of the neck it enters the thorax, on the right side by crossing the first part of the subclavian artery and on the left side by continuing between the common carotid artery and the left subclavian artery ; and from the thorax it is continued into the abdomen on the walls of the œsophagus. After emerging from the skull the vagus is joined by the cerebral part of the accessory nerve, and present on it there is an elongated ganglion (ganglion nodosum) about three-quarters of an inch in length (Fig. 37). The ganglion is closely connected to the first loop of the cervical plexus, the superior cervical sympathetic ganglion and, usually, to the hypoglossal nerve.

(Above the ganglion nodosum the vagus nerve has a second smaller

ganglion on it, the ganglion jugulare. It is connected to the facial and glosso-pharyngeal nerves and gives off a small meningeal branch and an auricular branch (Arnold's nerve). This nerve courses through the temporal bone and is finally distributed to the lower half of the membrana tympani and the skin lining the lower half of the external auditory meatus.)

The **branches** which arise from the vagus nerve in the neck are : (1) The **pharyngeal branch** which arises from the ganglion nodosum and passes downwards and forwards to end in the pharyngeal plexus (Fig. 37). This is a plexus of fine filaments formed on the wall of the pharynx by the pharyngeal branches of the glosso-pharyngeal and vagus nerves and of the superior cervical sympathetic ganglion. Twigs from it supply the muscles and the mucous membrane of the pharyngeal wall. (2) The **superior laryngeal** nerve also arises from the ganglion nodosum and runs downwards and forwards deep to the internal carotid artery (Fig. 37). It ends by dividing into the internal and external laryngeal nerves, both of which have already been dissected. The **internal** nerve enters the larynx by piercing the thyreo-hyoid membrane under cover of the thyreo-hyoid muscle, and is distributed to its mucous membrane; the **external** nerve descends to the crico-thyreoid muscle in which it ends. (3) The **recurrent** (or inferior) **laryngeal** nerve arises differently on the two sides. On the right side it arises as the vagus nerve crosses the first part of the subclavian artery, and hooking round that vessel it ascends into the neck. On the left side it springs from the vagus in front of the arch of the aorta and passing under the aorta ascends behind the common carotid artery into the neck. In the neck the nerve of each side proceeds upwards in the groove between the œsophagus and the trachea, and passes deep to the lateral lobe of the thyreoid gland where it lies in intimate relationship with the inferior thyreoid artery. It then passes under the lower border of the inferior constrictor muscle of the pharynx (Fig. 60) and enters the larynx, to all the muscles of which, except the crico-thyreoid, it is distributed (p. 192).

(Two **cardiac** branches arise from the vagus in the neck, one in the upper and one in the lower part. They pass downwards into the thorax posterior to the subclavian artery and there join the cardiac plexuses.)

The **hypoglossal** (twelfth cranial) **nerve** leaves the skull through the anterior condyloid canal and at first lies medial to the internal jugular vein and the internal carotid artery, and as a rule is intimately connected with the vagus nerve. It passes forwards between the vein and the artery and descends in that position to the lower border of the posterior belly of the digastric muscle. It then hooks round the lower end of the occipital artery and turns forwards and crosses the external carotid and lingual arteries. Further forwards it passes beneath the digastric tendon and the stylo-hyoid muscle and enters the digastric triangle, in which it disappears beneath the posterior border of the mylo-hyoid muscle. It is the motor nerve to the muscles, intrinsic and extrinsic, of the tongue, and it carries with it fibres from the first cervical nerve, which leave it as the descendens hypoglossi, the nerve to the thyreo-hyoid, and the nerve to the genio-hyoid (Fig. 26). Sometimes, however, the vagus nerve receives the communication from the first cervical nerve, and then the descending branch would be named descendens vagi.

The greater part of the **cervical sympathetic trunk** will have been displayed during the dissection of the neck. It takes a vertical course through the whole length of the neck, lying in

front of the roots of the transverse processes of the cervical vertebræ on the longus capitis and longus colli muscles, and behind the internal carotid artery above and the common carotid artery below. There are no white rami communicantes connecting it to the cervical spinal nerves, and the fibres which enter it from the spinal cord ascend into it from the thoracic sympathetic trunk with which it is continuous below. There are only three ganglia present on the cord, named, according to their positions, the superior, middle, and inferior cervical ganglia. The **superior ganglion** is a very definite fusiform enlargement about an inch in length, and lies opposite the second and third vertebræ. From its upper end the sympathetic trunk is continued upwards into the skull along the internal carotid artery as a well-defined cord, the internal carotid nerve. Its lower end tapers into the downward continuation of the trunk which connects it with the middle ganglion.

The **superior ganglion** is connected to the vagus, glosso-pharyngeal and hypoglossal nerves, and by grey rami communicantes to the upper four cervical nerves; and from it plexuses are distributed along the internal and external carotid arteries. There also arise from it a pharyngeal branch which joins the pharyngeal plexus, and the superior sympathetic cardiac nerve which runs downwards behind the common carotid artery into the thorax to join the deep cardiac plexus on the right and the superficial cardiac plexus on the left side.

The **middle ganglion** is the smallest of the ganglia and sometimes appears to be wanting. It lies at the level of the sixth cervical vertebra usually in front of, or close to, the inferior thyreoid artery.

The **middle ganglion** is connected to the fifth and sixth cervical nerves by grey rami communicantes, and gives off branches which run along the inferior thyreoid artery to the thyreoid gland. The middle cardiac nerve, the largest of the cervical sympathetic cardiac nerves, also arises from it; it descends into the thorax behind the common carotid artery and joins the deep cardiac plexus.

The **inferior ganglion** lies deeply in the hollow between the base of the transverse process of the last cervical vertebra and the neck of the first rib; in this position it is posterior to the vertebral artery. It is connected to the middle ganglion by two or more cords, one of which passes in front of the first part of the subclavian artery, the loop thus formed being named the ansa subclavia (Vieussens). These cords having been found, the subclavian artery will require to be turned medially, the superior intercostal artery being cut, in order to expose the ganglion.

The **inferior ganglion** sends grey rami communicantes to the seventh and eighth cervical nerves, and gives off plexuses which pass along the subclavian artery and its branches, and the inferior cardiac nerve. This nerve passes behind the subclavian artery into the thorax and joins the deep cardiac plexus.

The **thyreoid gland** belongs to the group of the ductless glands. It will, by this time, be somewhat shrunk in size and hardened from its naturally soft condition, and probably displaced a little from its position; but the present is the most convenient time to study its form and relations. It is very variable in its size and even in its shape, but generally it is larger in women than in men and typically it consists of two massive **lateral lobes** connected together across the front of the trachea by a narrow median part named the **isthmus**. The lateral lobes are conical masses, the bases being directed downwards, and lie along the side of the trachea and the larynx, extending from about the fifth or sixth tracheal ring below to the lower part of the thyreoid cartilage above. Each of the lobes is covered in front by the infrahyoid muscles and is moulded behind to the structures on which it lies, namely, the side of the trachea and the cricoid and thyreoid cartilages; and it usually extends backwards to touch the lateral margins of the œsophagus, especially on the left side, and the lateral wall of the lower part of the pharynx. Frequently, also, it overlaps the common carotid artery (Fig. 39). The isthmus connects the lower parts of the lateral lobes. It usually covers the second and third rings of the trachea but is inconstant in size, shape, and position; sometimes, indeed, it is altogether wanting. In other subjects a pyramidal lobe of thyreoid substance may ascend from its upper border, more usually to the left of the middle line; it may end in a free pointed process or be connected to the hyoid bone by a fibrous cord or a narrow slip of muscular fibres, the levator glandulæ thyreoideæ (p. 62). The thyreoid gland is enclosed in a sheath of fibrous tissue through which it is firmly attached to the parts on which it lies; it therefore follows the larynx in all its movements. The rich blood supply of the thyreoid gland has already been described. The superior and inferior thyreoid arteries are distributed to it on each side and occasionally there is a small median vessel, the thyreoidea ima artery which ascends to the isthmus; and the veins which leave the organ are three in number on each side, the superior and middle of which join the internal jugular vein, while the inferior thyreoid vein enters the innominate vein.

The structure of the thyreoid gland cannot be studied satisfactorily in the dissecting-room, and it is not usually possible to demonstrate the **parathyreoid glands.** If a fresh thyreoid gland be procured from the post-mortem, however, they may be found. They are two in number on each side, and though varying a good deal in position, they usually lie in close proximity to the posterior surface of the lateral lobe of the thyreoid gland, one above and one below the inferior thyreoid artery. The glands are invested by a fibrous capsule, even when they are more or less completely embedded in the thyreoid gland.

The thyreoid gland should be removed from the neck so that the cervical parts of the **trachea** and the **œsophagus** may be

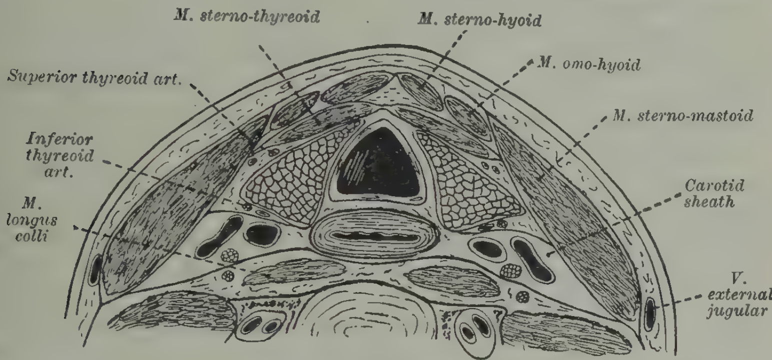


FIG. 39.

*Transverse section of the neck.* The relations of the thyreoid gland, the trachea and the œsophagus, and of the contents of the carotid sheath are to be studied. The layers of the deep cervical fascia are represented diagrammatically; the cervical sympathetic cord lies behind the prevertebral layer.

examined. They are the continuations, respectively, of the larynx and pharynx, and each of them begins at the level of the cricoid cartilage in front of the sixth cervical vertebra; and they pass downwards anterior to the vertebral column, the trachea in front of the œsophagus, into the thorax (Fig. 39). The recurrent laryngeal nerve ascends on each side in the groove between them.

The **œsophagus**, a muscular-walled tube and flattened from before backwards, rests on the longus colli muscles to which it is connected by loose areolar tissue. Its cervical part is short, for at the level of the first thoracic vertebra it passes into the thorax. At its commencement it lies in the middle line, but as it descends to the root of the neck it inclines a little to the left side. It thus comes more closely into relationship with the lateral lobe of the

thyreoid gland and the carotid sheath on the left than on the right side.

The **trachea** is a wide tube, not quite cylindrical, which is kept patent by the cartilaginous rings (tracheal rings) embedded in its wall. The rings are deficient posteriorly, so that the posterior surface of the trachea which rests on the œsophagus is flattened (Fig. 39). Its anterior surface is covered, from above downwards, by the isthmus of the thyreoid gland, the inferior thyreoid veins, and the sterno-thyreoid and sterno-hyoid muscles; and it is crossed, superficial to the deep fascia of the neck, by the transverse branches between the anterior jugular veins. Laterally it is related to the common carotid artery, the inferior thyreoid artery, and the lateral lobe of the thyreoid gland (Fig. 39). The cervical part of the trachea is only about one inch in length when the head is vertical and the face looks forwards, but can be greatly lengthened if the head be thrown backwards.

The **scalene muscles** are now to be studied. They are three in number and are named, from their position, anterior, medius, and posterior; and they extend from the transverse processes of the cervical vertebræ to the upper two ribs. The anterior and medius muscles, both of which are attached to the first rib, are separated from one another by the roots of the brachial plexus and the subclavian artery; while the posterior muscle, which is generally inseparable from the medius at its origin, is attached below to the second rib and therefore easily defined. The scalene muscles are supplied by branches from the anterior divisions of the lower four or five cervical nerves.

The **scalenus anterior** arises from the anterior tubercles of the transverse processes of the third to the sixth cervical vertebræ, and descending almost vertically is inserted by a narrow tendon into the scalene tubercle on the inner border of the first rib and into the ridge on its upper surface between the two subclavian grooves. Many of the most important structures of the neck have been described in relation to it; the phrenic nerve descends on its surface; the subclavian artery lies behind it and the subclavian vein in front of it at its insertion; the common carotid artery lies along its attachments to the transverse processes and the internal jugular vein is placed between it and the sterno-mastoid muscle; and the roots of the brachial plexus appear at its lateral border.

The **scalenus medius** muscle, the largest of the scalene group, arises from the posterior tubercles of the transverse processes of all the cervical vertebræ except the first, and is inserted on the upper surface of the first rib between its tubercle and the groove for the subclavian artery. Some of its fibres end in the fascia covering the dome of the pleura (Sibson's fascia). It forms part of the floor of the posterior triangle of the neck below and in front of the levator scapulæ (Fig. 25), and on its

surface the brachial plexus and the third part of the subclavian artery were dissected; and piercing it there have been found the nerve to the rhomboids and the upper parts of the long thoracic nerve.

The **scalenus posterior** is the smallest of the three scaleni. It arises from the posterior tubercles of the transverse processes of the lower two or three cervical vertebræ and is inserted into the upper border of the second rib behind the attachment of the serratus magnus.

In the interval between the transverse process of the atlas and the under surface of the skull and behind the commencement of the internal jugular vein, a small muscle, the **rectus capitis lateralis**, should be defined. It arises from the upper surface of the transverse process of the atlas and is inserted into the jugular process of the occipital bone. The anterior division of the first cervical nerve, which supplies it, emerges at its medial border and passes downwards behind the internal jugular vein to join the second nerve and form the first loop of the cervical plexus (Fig. 26).

## REMOVAL OF THE BRAIN AND DISSECTION OF THE BASE OF THE SKULL

The further dissection of the head and neck can only be carried out after the brain has been removed from the cranial cavity. The tissues of the scalp, therefore, are to be cleaned away from the calvarium so that the bone is left perfectly bare over an area bounded in front by the superciliary lines, behind by the external occipital protuberance, and at the sides reaching well below the temporal ridges. The saw is then to be carried round the skull at a level which in front should be about an inch above the orbits and behind should pass through the most prominent part of the occipital bone. Only the external table of the skull is to be sawn through, the depth of the saw being easily gauged by the softness of the diploe between the two tables. The inner table is to be broken by the use of the chisel and the mallet, with which it may be cracked completely round by a few strokes. The chisel should then be inserted into the saw-cut and turned forcibly round so as to wrench the calvarium away from the dura mater which is sometimes strongly adherent to its deep surface; considerable force may be used, however, without any damage to the contents of the cranium.

It is to be noted at once that the deep surface of the removed calvarium is entirely devoid of any periosteal investment, for the internal periosteum of the skull takes part in the formation of the

cranial **dura mater.** On either side of the middle line small circular excavations of the bone are usually to be seen and if the skull-cap be held to the light it is so thin at these parts as to be almost transparent. These excavations are produced by the **Pacchionian corpuscles** (arachnoid granulations) which appear to have eaten away the bone for their lodgment. These bodies may be seen on the exposed part of the dura mater particularly in old subjects; they are irregular, granular, fleshy-looking bodies whose structure will be better understood when the dura mater is raised.

In the middle line of the dura mater a venous channel, the **superior sagittal sinus**, can be recognised. It should be opened into so as to exhibit its size and shape; the manner of its formation can be understood only by reference to the structure of the **dura mater.**

The cranial **dura mater** consists of two layers, which are firmly adherent to one another. The outer layer is the internal periosteum of the bones of the cranial cavity, while the inner layer is comparable with the dura mater of the spinal cord and is the true covering of the brain. These layers may therefore be named the **periosteal** layer and the **cerebral** layer. Along certain lines, however, the two layers separate from one another; at some places to form the large venous channels named the cranial sinuses, and at others that the cerebral layer may form folds or partitions which pass in between certain parts of the brain (Fig. 73).

It is, of course, the surface of the periosteal layer which has been exposed. It is rough, due to the fibrous processes which connect it with the bones and to the small veins which enter it from them; the latter having been torn in the removal of the skull-cap will appear on the dura as small bleeding points. The dura mater is not equally adherent to the bones in different localities. It is much more firmly attached to the bones of the base than to the vault of the cranium, where in the adult at least it is firmly attached only along the lines of the sutures. In the child and again in old age it is more firmly bound to the bones.

The **middle meningeal artery** should be recognised on each side. It ascends and branches freely. It lies on the surface of the dura mater, and in addition to supplying this membrane also gives off the nutrient arteries of the inner table and the diploe of the cranial bones. The branches of the artery are accompanied by veins, and if the inner surface of the skull-cap be examined it will be seen to be deeply grooved for their lodgment.

The dura mater is now to be incised on each side of the superior sagittal sinus from the frontal bone in front to the occipital bone behind. The lateral flaps of dura mater, thus defined, are to be divided transversely about the middle and the four flaps now formed are to be turned downwards. A large part of the surface

of the brain covered by **arachnoid** will be exposed. The space which has been opened into between the dura and the arachnoid, the **subdural space**, is a mere cleft; it contains a lymph-like fluid. It will be noted at once that the deep surface of the dura mater is smooth and shining; it is, of course, the deeper of the two layers described above, the cerebral dura mater or dura mater proper.

The medial strip of dura mater has now to be raised from the underlying brain on each side towards the middle line. Numerous veins will be encountered passing from the surface of the brain across the subdural space to the superior sagittal sinus; they run forwards in the walls of the sinus before entering it, so that the currents of blood emerging from them are directed forwards against the current in the sinus. These veins are to be divided. If each of the cerebral hemispheres be now turned slightly outwards from the middle line a reduplication of the cerebral layer of dura mater, the **falx cerebri**, will be exposed between them. It is not possible to define the attachments of this process of dura mater, but its position between the two hemispheres and its sickle shape can be seen.

The superior sagittal sinus is to be slit open along its whole length from behind forwards. Its position relative to the dura mater can now be understood; it lies between the two layers, its roof being formed by the periosteal layer and its converging sides by the cerebral layer which is inflected to form the falx cerebri (Fig. 73).

The **superior sagittal sinus** commences anteriorly at the ethmoid bone, where it often communicates with the small vein which enters the skull from the nose through the foramen cæcum. It runs backwards in the middle line, grooving the cranial bones, to the internal occipital protuberance and here it deviates to one or other side, usually the right, and becomes continuous with the lateral sinus. Its lumen is triangular in section, small in front but much larger behind, and it is crossed by small tendinous cords. Opening into the sinus on each side there are a number of irregular spaces, named lacunæ, and there are also to be seen the mouths of the veins from the upper surface of the cerebral hemisphere (superior cerebral veins). It has already been noted that the terminal parts of the veins are directed forwards while the blood in the sinus flows backwards. The sinus also receives numerous small veins from the cranial bones and two veins from the pericranium, one on each side, which pass through the parietal foramina (parietal emissary veins).

The narrow anterior part of the falx cerebri is to be cut through and it is to be pulled forcibly backwards. The upper surface of the cerebral hemispheres is now fully exposed and between these the great longitudinal intercerebral fissure which

was occupied by the falx. In the free edge of the falx there is a small venous channel, the **inferior sagittal sinus**, running along its whole length from before backwards.

The removal of the brain is now to be undertaken. If it is obviously useless for the purposes of dissection it should be cleared away piecemeal, leaving the various folds of dura mater in position; often, however, the parts below the tentorium cerebelli can be preserved when the parts above are too soft to be of use. If the brain has been properly injected it should be removed entire, but if it has become too hard, the mid-brain must be divided and the organ removed in two parts; this alternative, however, should not be resorted to unless it is absolutely necessary.

The head is to be raised on a block and allowed to hang well back. The anterior parts of the hemispheres are to be raised from the orbital plates of the frontal bone and the **olfactory bulbs** and **tracts** are to be raised with them; frequently, however, this is not possible as the olfactory bulbs remain bound to the cribriform areas of the ethmoid bone. The hemispheres are to be pulled still further back until the **optic nerves** entering the optic foramina are clearly exposed. They are to be cut across about a quarter of an inch behind the foramina and then the **internal carotid arteries** which lie close to their lateral sides are to be similarly treated. In the middle line the delicate **infundibulum** of the **pituitary gland**, if it be not already broken, will now be seen as it passes from the base of the brain into the sella turcica in which the pituitary gland is lodged. If necessary it is to be divided. The third pair of cranial nerves, the **oculo-motor** nerves, will then come into view and are to be severed close to the anterior clinoid processes. The fourth, the **trochlear**, nerves usually break of themselves. The side and back parts of each hemisphere must now be raised in turn until the back parts of the petrous temporal bones are reached. Some small veins passing from the under surface of the brain into the dura mater have usually to be divided to allow this to be done. A more or less horizontal membrane will now be seen extending backwards from the petrous bones between the cerebral hemispheres above and the cerebellum below; this is the **tentorium cerebelli**. It has a free curved edge, bounding an opening through which the mid-brain passes, and is attached laterally to the side wall of the skull. It is to be divided close to its lateral attachment from in front as far back as possible, first on one side and then on the other, care being taken not to injure the cerebellum. The fifth cranial, the **trigeminal**, nerves are then to be cut across close to

the points at which they pierce the dura mater, and continuing to pull the brain backwards, the **facial** (seventh) and **auditory** (eighth), the **glosso-pharyngeal** (ninth), **vagus** (tenth), and **accessory** (eleventh) and the **hypoglossal** (twelfth) nerves are to be severed close to the foramina at which they make their exit from the skull. The **abducent** (sixth) nerves usually break of themselves.

The **vertebral arteries** and the **spinal cord** are then to be divided through the foramen magnum as far down as possible, and by manipulating the cerebellum past the cut edges of the tentorium cerebelli, the head hanging well over the end of the table, the whole brain may be delivered from the skull cavity. It is to be laid, base upwards, in a jar of preserving fluid, on the bottom of which there is some tow or cotton wool, so that it may be properly hardened for future dissection.

The parts which remain within the cranium are to be studied, the head being supported on a block so that the floor of the cranial cavity looks upwards.

The reduplications of the cerebral layer of the dura mater which divide the cavity of the skull and separate the major portions of the brain from one another should be examined first. They are the **falx cerebri**, the **tentorium cerebelli**, and the **falx cerebelli**.

The **falx cerebri**, so named from its sickle shape, is a highly arched process which descends vertically in the interval between the cerebral hemispheres. It is narrow in front where it is attached to the crista galli of the ethmoid bone, but much broader behind where it is attached in the middle line to the upper surface of the tentorium cerebelli. The anterior narrow part is sometimes perforated by numerous apertures. The superior sagittal sinus runs along the upper attached margin while the inferior sagittal sinus runs along its concave and free lower border. The straight sinus lies along its attachment to the tentorium.

The **tentorium cerebelli** is a transversely placed layer of dura mater and intervenes between the cerebellum below and the hinder parts of the cerebral hemispheres above. While its general direction, however, is transverse, it is arched upwards as if pulled on by the falx cerebri. Its attached border runs horizontally round the skull, being fixed to the occipital bone behind and along the superior borders of the petrous parts of the temporal bones in front; but its anterior concave border is free and bounds the opening which is occupied by the mid-brain. On each side, at the apex of the petrous part of the temporal bone, the free and attached margins cross one another and are continued forwards to be attached, respectively, to the anterior and the posterior clinoid process.

The **falx cerebelli** (Fig. 40) is a small, vertical, median process which is situated below the tentorium and projects forwards between the lateral lobes of the cerebellum. Its posterior margin is attached to the internal occipital crest and its base to the under surface of the

tentorium; while its apex frequently divides into two small folds which are lost on the sides of the foramen magnum.

There are two studies which the student has now to make within the cranial cavity, namely: (1) the position and arrangement of the **cranial venous sinuses**, and (2) the dissection of the intracranial portions of the **cerebral nerves** and the definition of the foramina through which they make their exit from the skull. These two studies, however, are best combined and carried out successively in each of the three cranial fossæ; and there fall to be described with them the **arteries** of the **dura mater** (the meningeal arteries) and the intracranial portion of the **internal carotid artery** (Fig. 40).

The **anterior fossa** of the skull is limited behind by the sharp posterior margins of the lesser wings of the sphenoid bone. In it in the median plane in front is the projecting crista galli which partially subdivides the fossa into lateral halves; attached to the crista is the falx cerebri. On either side of the crista there is the depressed portion of the fossa in which the **olfactory bulb** is lodged; its floor is formed by the cribriform plate of the ethmoid bone. It is not usually possible to see the **olfactory nerves**, which as very fine filaments pass through the foramina of the cribriform plate and join the under surface of the olfactory bulb. Lateral to the cribriform plate, the floor of the anterior fossa forms the roof of the orbit; it bulges upwards as a well-marked convexity, the surface of which usually presents several prominent sharp ridges. The posterior border of the small wing of the sphenoid bone terminates medially in the anterior clinoid process. Running along it there is the small **spheno-parietal venous sinus**; it opens into the anterior end of the cavernous sinus (Fig. 40).

The **middle fossa** of the skull comprises a small, square, **median** portion bounded by lines joining the four clinoid processes of the sphenoid bone, and two large **lateral** portions, each of which is bounded in front by the thin curved posterior edge of the small wing of the sphenoid and behind by the superior margin of the petrous part of the temporal bone. In the median part, on each side and just medial to the anterior clinoid process, the **optic nerve** will be seen passing forwards into the optic foramen and on the lateral side of the nerve there is the cut end of the **internal carotid artery** (Fig. 40); and arising from the artery there is to be secured its **ophthalmic** branch which runs forwards below the nerve into the orbit. Behind and between the two internal carotid arteries, and in the middle line, the **infundibulum** will be seen passing

through a narrow circular opening in the dura mater into the sella turcica; and more posteriorly there are the posterior clinoid processes. The aperture for the infundibulum is in the centre

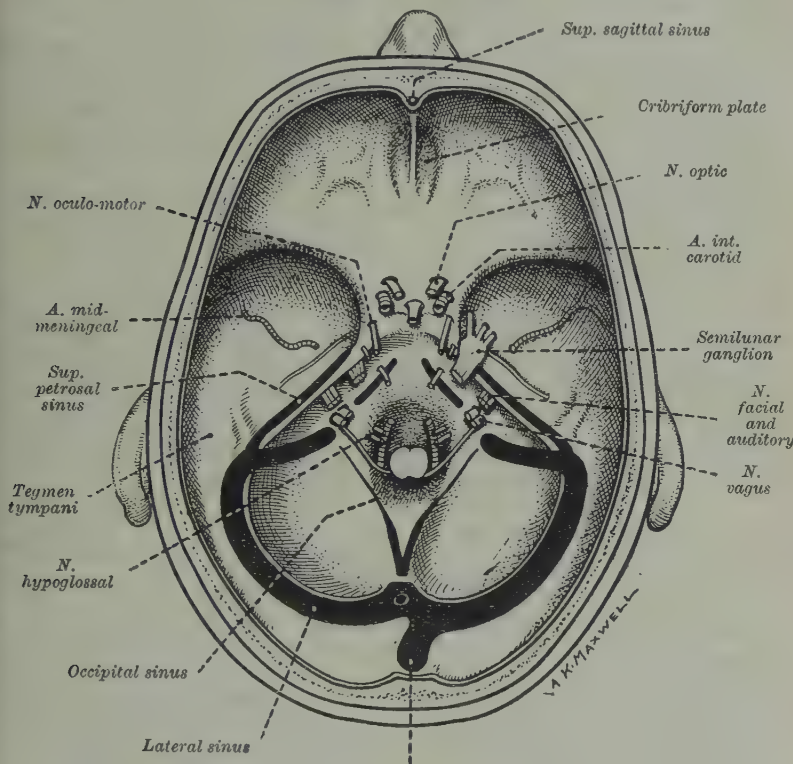


Fig. 40.

*A diagram of the base of the skull after the removal of the brain.* The following structures should be named: the infundibulum, the trochlear nerves, the great superficial petrosal nerve (on the right side), the inferior petrosal sinuses, the abducent nerves, the glosso-pharyngeal nerves, the spinal parts of the accessory nerves and the vertebral arteries.

of a fold of the cerebral layer of the dura mater, the **diaphragma sellæ**, which roofs the sella turcica and covers the **pituitary body**. In its anterior and posterior margins there are small transverse sinuses which connect together the two **cavernous sinuses**. These large channels lie one on each side of the sella turcica.

The margins of the tentorium cerebelli should be followed forwards from the apex of the petrous temporal bone to their terminal attachments. The lateral or attached margin extends to the posterior clinoid process while the central free margin crosses it and extends forwards to the apex of the anterior clinoid process. Between these two attachments of the tentorium the **oculo-motor nerve** pierces the dura mater, and at the point where the two margins cross one another the delicate **trochlear nerve** will be seen, if the free margin be turned laterally; both nerves pass forwards into the lateral wall of the cavernous sinus.

The overhanging margin of the diaphragma sellæ is to be cut away and the **pituitary body** carefully removed from the sella turcica so that it may be examined.

The **pituitary body** belongs to the group of ductless glands. It is an oval body, its longer axis being transverse, and is slightly flattened from above downwards. It is connected to the tuber cinereum of the brain by the infundibulum which is attached to its posterior part. If a vertical antero-posterior section be made through the centre of the gland it will be seen to consist of two parts, a large anterior lobe which is hollowed out behind to receive the small posterior lobe. The infundibulum is connected to the posterior lobe alone.

The **spheno-parietal sinus**, which runs along the posterior margin of the small wing of the sphenoid bone, is to be opened and followed medially to the **cavernous sinus**, which itself has now to be explored by the removal of the dura mater forming its lateral wall. The dura is to be divided from the anterior clinoid process to the apex of the petrous part of the temporal bone, the incision passing just lateral to the openings through which the oculo-motor and trochlear nerves pass. The division of the dura should be continued a little way backwards along the superior border of the petrous portion of the temporal bone, and the flap of membrane thus defined should be carefully reflected laterally. It forms the lateral wall of the cavernous sinus, and immediately underlying it are the oculo-motor and trochlear nerves which are to be preserved; while over the apex of the petrous bone it is connected to the surface of the **semilunar** (Gasserian) **ganglion** of the **trigeminal nerve** which must be exposed. The space between the two layers of the dura, cerebral and periosteal, which contains the ganglion is usually named "Meckel's cave." From the postero-medial border of the ganglion the trunk of the trigeminal nerve passes backwards over the margin of the petrous bone into the posterior fossa of the skull where it pierces the cerebral dura;

while from its antero-lateral border the three divisions of the nerve pass forwards. The **ophthalmic** (first) division passes anteriorly in the lateral wall of the cavernous sinus; the **maxillary** (second) division runs to the foramen rotundum; while the **mandibular** (third) division proceeds to the foramen ovale.

The **cavernous sinus** is a short channel of irregular form which lies on the side of the body of the sphenoid bone. It commences in front at the medial end of the sphenoidal fissure by the union of the ophthalmic veins from the orbit, and it terminates behind at the apex of the petrous temporal bone by opening into the superior and inferior petrosal sinuses. The sinuses of the two sides communicate with one another through the small anterior and posterior intercavernous sinuses in the diaphragma sellæ, and each is connected with the pterygoid

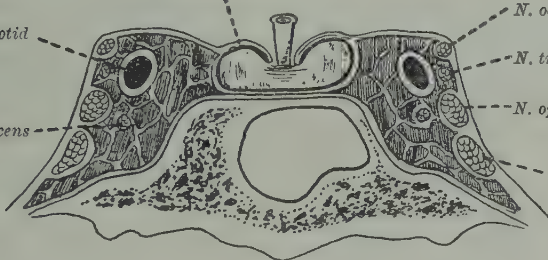


Fig. 41.

*Transverse section through the sella turcica to show the pituitary body and the cavernous sinuses.*

and pharyngeal plexuses by small emissary veins which leave the skull through the foramen ovale, the foramen lacerum, and the carotid canal. It should also be remembered that since the superior ophthalmic vein communicates with the commencement of the angular vein, the cavernous sinus is brought into connection with the superficial veins of the face. The tributaries of the sinus, in addition to the ophthalmic veins and the spheno-parietal sinus, are the superficial cerebral veins from the lower part of the lateral surface and from the inferior surface of the cerebral hemisphere.

The cavernous sinus derives its name from the fact that traversing its lumen there are numerous interlacing trabeculæ; and passing forwards among these there are to be secured the **internal carotid artery** surrounded by the internal carotid **sympathetic plexus**, and below the artery behind, but on its lateral side in front, the **abducent** (sixth) **nerve**. This nerve pierces the dura mater in the posterior fossa over the lower and lateral part of the dorsum sellæ, and passes forwards into the sinus. In the lateral

wall of the sinus there have already been defined the oculo-motor, trochlear, and ophthalmic nerves in that order from above downwards; and these, with the abducent nerve, pass forwards in the sinus to the sphenoidal fissure through which they enter the orbit. In the dissection of the orbit they will be studied more fully.

The **semilunar** (Gasserian) **ganglion** of the **trigeminal nerve** occupies a cavity, the "cave of Meckel," between the two layers of dura mater, and lies in a slight depression near the apex of the petrous part of the temporal bone. It is somewhat crescentic in shape and appears to be formed of a dense interlacement of fibres. The concavity of the ganglion is directed postero-medially, and from it the fibres of the **sensory root** pass backwards towards the pons of the brain; while from the convexity of the ganglion the three divisions of the nerve emerge. These are the ophthalmic, the smallest division, composed entirely of sensory fibres, which passes forwards in the cavernous sinus and through the sphenoidal fissure into the orbit; the maxillary division, also entirely sensory, which runs forwards for a short distance in the lower and lateral part of the cavernous sinus and disappears through the foramen rotundum; and the mandibular division which almost immediately leaves the cranial cavity through the foramen ovale. In addition to sensory fibres the mandibular nerve contains motor fibres which are distributed to the muscles of mastication. These fibres form the **motor root** of the trigeminal nerve. It also is attached to the pons, and runs forwards at first on the medial side of the sensory root and then on the deep surface of the semilunar ganglion to which, of course, it is not attached; it can be displayed there as a firm round bundle and followed to the foramen ovale where it joins the mandibular nerve.

The part of the **internal carotid artery** which lies in the cavernous sinus is now to be cleaned and examined. This artery was followed, in the dissection of the neck, to the under surface of the temporal bone through which it passes in the carotid canal. It emerges from this canal at the apex of the petrous bone and crosses the upper part of the foramen lacerum; and having turned upwards and pierced the outer layer of the dura mater it passes horizontally forwards on the side of the body of the sphenoid bone in the cavernous sinus. At the root of the small wing of the sphenoid it turns abruptly upwards and pierces the inner layer of the dura mater on the medial side of the anterior clinoid process and close to the optic foramen. It was sectioned at this point when the brain, to which it is distributed, was removed. Throughout its course it is surrounded by a plexus of sympathetic fibres which, however, can hardly be dissected. While in the cavernous sinus it gives small branches to the pituitary body, the semilunar ganglion, and the dura mater, and close to the optic nerve the **ophthalmic artery**, a branch of some size, arises from it; it runs forwards below the optic nerve to the orbit.

The **middle meningeal artery** is to be defined as it enters the skull through the foramen spinosum by cutting through the dura mater, and is to be traced forwards and laterally across the floor of the middle fossa. As it reaches the lateral wall of the skull it divides into an anterior and a posterior branch; the former of these ascends on the great wing of the sphenoid to the anterior inferior angle of the parietal bone, grooving both deeply, while the posterior branch passes upwards and backwards on the squamous part of the temporal bone. Both trunks send off numerous branches which spread out widely, and with the accompanying veins occupy well-marked grooves on the inner surface of the cranial vault.

The **meningeal arteries** are the nutrient arteries of the dura mater and of the inner table and diploe of the cranial bones. They are derived from a number of sources, but the only vessel of conspicuous size is the **middle meningeal** branch of the internal maxillary artery described above; the others are small twigs and not easily secured in an ordinary dissection. The **small meningeal** artery may be secured in a well injected subject, though it is somewhat inconstant. It arises from the middle meningeal or directly from the internal maxillary artery and enters the skull through the foramen ovale by the side of the mandibular nerve; it is distributed in the middle fossa in the neighbourhood of the semilunar ganglion. In the anterior fossa there are small **anterior meningeal** branches derived from the anterior ethmoidal artery; and in the posterior fossa there are **posterior meningeal** twigs from the ascending pharyngeal artery which enter through the jugular foramen and the foramen lacerum, from the occipital artery which enter through the jugular and mastoid foramina, and from the vertebral artery which enter through the foramen magnum.

The meningeal arteries are accompanied by **meningeal veins**, but those which accompany the branches of the middle meningeal artery are the only ones which will be seen. These vessels are larger than the corresponding arteries and lie external to them in the grooves in the cranial bones. The ultimate vein which is formed accompanies the middle meningeal artery through the foramen spinosum and ends in the pterygoid plexus. There are also small meningeal veins which open separately into the cranial venous sinuses.

The **eminentia arcuata** on the upper (anterior) surface of the petrous bone should now be recognised. The dura mater lateral to it should be removed and the area of the temporal bone thus exposed carefully examined; it is the **tegmen tympani**, the roof of the tympanic cavity and the tympanic antrum, and in many subjects is so thin as to be translucent. The **great superficial petrosal nerve** is then to be sought just medial to the anterior end of the eminentia arcuata; it appears through the **hiatus canalis facialis** (aqueduct of Fallopius) and runs forwards and medially beneath the semilunar ganglion (Fig. 40).

The **great superficial petrosal nerve** can usually be readily exposed, with a small twig of the middle meningeal artery, in a groove on the surface of the petrous bone which extends from the hiatus canalis facialis to the lacerate foramen. It is a branch of the facial nerve, arising in the facial canal, and having emerged from it passes forwards and medially under the semilunar ganglion and enters the foramen lacerum. It is joined there by the **deep petrosal nerve**, a sympathetic filament from the carotid plexus, and the trunk thus formed, the **Vidian nerve**, passes through the base of the skull to the spheno-palatine (Meckel's) ganglion.

The **small superficial petrosal nerve** should also be sought. It appears through an opening immediately lateral to the hiatus canalis facialis and runs across the surface of the petrous bone to the interval between it and the great wing of the sphenoid, through which (or through the foramen ovale) it leaves the skull to reach the otic ganglion. It arises from the tympanic plexus in the tympanic cavity and contains fibres of the glosso-pharyngeal nerve and possibly of the facial nerve (p. 159).

The **posterior fossa** of the skull should now be examined. In the foramen magnum, and extending down the vertebral canal, lies the upper end of the **spinal cord**, which was sectioned in the removal of the brain; it is attached on each side to the margin of the foramen by the highest digitation of the **ligamentum denticulatum.** The **vertebral arteries**, ascending into the cranial cavity through the foramen magnum, lie in front of the ligament, and in front of them are the **anterior roots** of the **first cervical nerves.** At a higher level on each side the **hypoglossal nerve** pierces the dura mater; it is in two parts and these pass into the anterior condyloid foramen behind the vertebral artery (Fig. 40). The **spinal root** of the **accessory nerve** should then be identified; it enters the cranium through the foramen magnum behind the ligamentum denticulatum and turns laterally to join the **medullary** part of the nerve. This nerve and the **vagus nerve** then pass through the dura mater together opposite the jugular foramen and immediately above them the small **glosso-pharyngeal nerve** pierces the dura. The **auditory** and **facial nerves** pass together into the internal auditory meatus accompanied by a small artery, the internal auditory branch of the basilar artery; the large motor part of the facial nerve lies highest and the auditory nerve lowest, the small sensory part (pars intermedia) of the facial being situated between these two. The **trigeminal nerve** has already been described to pass through an opening in the dura close to the margin of the petrous temporal bone while the **abducent nerve** pierces the dura over the base of the dorsum sellæ.

The **venous sinuses** of the posterior fossa are now to be studied. In the back part of the lower free edge of the falx cerebri there is

a small channel, the **inferior sagittal sinus**, which terminates posteriorly in the **straight sinus**. The straight sinus is situated along the line of junction of the falx cerebri with the tentorium cerebelli. It is to be opened along its whole length and then the falx cerebri should be cut away from its attachment to the tentorium and the occipital bone. As this is done the lower part of the **superior sagittal sinus** will be cut across, and the dissector may now demonstrate that over the internal occipital protuberance it turns to the right (in the majority of subjects) and becomes continuous with the right **lateral sinus** which runs horizontally along the attached border of the right half of the tentorium. In the same way the straight sinus turns to the left and becomes continuous with the left lateral sinus (Fig. 40). In a certain number of subjects, however, this arrangement is reversed. As a general rule the two lateral sinuses communicate with one another over the occipital protuberance, while occasionally the superior sagittal, the two lateral sinuses, and the straight sinus unite there in a common dilation, which has been named the torcular Herophili. In the attached margin of the falx cerebelli there is the small **occipital sinus**; it commences near the foramen magnum in two branches which may communicate with the lateral sinuses, and terminates above in (usually) the left lateral sinus.

The **lateral sinus** should now be opened on each side by cutting through the attached border of the tentorium cerebelli. It lies in it as far as the lateral end of the superior border of the petrous part of the temporal bone, but at this point it dips downwards out of the tentorium on to the floor of the posterior fossa. At the point at which it bends downwards it is joined by the **superior petrosal sinus** which runs along the superior margin of the petrous bone from the posterior end of the cavernous sinus. This sinus should be opened and its connections established. The tentorium cerebelli can then be cut away. The lateral sinus is now to be followed in its curved course across the floor of the posterior fossa to the back part of the jugular foramen, through which it passes to be continued into the internal jugular vein.

The **lateral sinuses** (Fig. 40) are of large, though frequently of unequal, size. They begin at the internal occipital protuberance, one, generally the right, being the continuation of the superior sagittal sinus, the other of the straight sinus. Each passes horizontally forwards across the occipital bone and the posterior inferior angle of the parietal bone in the attached margin of the tentorium cerebelli. At the base of the petrous bone, however, it turns downwards and medialwards to reach the posterior part of the jugular foramen, resting in this part

of its course on the inner surface of the mastoid part of the temporal bone and the jugular process of the occipital bone and grooving them deeply. This part of the sinus is called the **sigmoid** portion, on account of the curved course it takes; opening into it about midway the dissector should locate the mouth of the mastoid emissary vein. The lateral sinuses carry into the internal jugular veins all the main venous streams of the cranial cavity except those of the inferior petrosal sinuses.

The **inferior petrosal sinus** should now be opened (Fig. 40). It begins in the posterior part of the cavernous sinus and runs backwards in the groove between the petrous part of the temporal bone and the basilar part of the occipital bone to the anterior part of the jugular foramen, through which it passes to open into the upper end of the internal jugular vein. It receives the internal auditory vein and veins from the medulla, the pons, and the under surface of the cerebellum. The sinuses of the two sides are connected across the basilar part of the occipital bone by a plexus of small channels.

The venous sinuses of the cranium are connected at certain places to the veins which lie on the exterior of the skull by small blood channels named **emissary veins**. Some of these veins are more constant than others, and it is of some clinical importance to know their position; for inflammatory processes may be conducted along them from the exterior to the interior of the skull, and, in the second place, blood may be abstracted from the sinuses through them. The more important emissary veins are: (1) A **mastoid** vein which runs through the mastoid foramen and connects the sigmoid part of the lateral sinus with the posterior auricular veins; leeches were commonly applied behind the ear, therefore, to relieve cerebral congestion. (2) A **parietal** vein passes through the parietal foramen and connects the superior sagittal sinus with the veins of the scalp. (3) A vein passes through the foramen cæcum and connects the superior sagittal sinus with the veins of the nose; nasal bleeding, therefore, especially in children, may beneficially drain the cerebral circulation. (4) A **condyloid** vein passes through the posterior condyloid foramen and connects the end of the lateral sinus with the veins of the suboccipital region. (5) Emissary veins connect the cavernous sinus with the pterygoid plexus through the foramen ovale, and with the pharyngeal plexus through the carotid canal and the foramen lacerum; and it has already been stated that the superior ophthalmic vein connects the cavernous sinus with the angular vein of the face.

## DISSECTION OF THE ORBIT

The orbit is to be opened by the removal of its roof and its contents are to be dissected from above. The soft parts of the forehead should be reflected downwards from the frontal bone as far as the upper orbital margin. Vertical saw-cuts are then to be

made at the medial and lateral ends of the orbital opening, and between these a horizontal incision should be made close above the supraorbital arch. The skull wall above the orbital opening can now be knocked away with the mallet, only a thin rim of bone being left round the upper boundary of the orbit. The roof of the orbit is then to be cut away with the chisel and the bone forceps. In some subjects, when the frontal sinus is large, two layers of bone will require to be removed, but as a rule there is only one thin plate of bone. The dissection is to be carried backwards until the sphenoidal fissure is fully opened up, so that the various nerves which enter the orbit through it from the cavernous sinus may be easily followed. A ring of bone, however, should be left round the optic foramen.

The bony roof of the orbit being removed, the **periosteum** which clothes its under surface will be exposed, for it is but loosely attached to the bone and remains in position. It is continuous behind, through the sphenoidal fissure, with the cranial dura mater, while in front, round the margins of the orbit, it is continuous with the periosteum on the surface of the skull. It is to be divided along the middle line and then transversely close to the orbital opening, both incisions being made very carefully so as not to injure the structures immediately deep to it. When it is reflected, the large **frontal nerve** lying on the upper surface of the **levator palpebræ superioris** muscle will be seen, but the other structures of the cavity are embedded in soft fatty tissue which must be carefully pulled away in small pieces to expose them. Thus, running along the medial wall of the orbit the **superior oblique** muscle can be readily defined, and lying upon and entering the posterior part of the muscle the small **trochlear nerve** will be found. As the muscle is followed forwards it will be seen to end in a slender tendon which passes through a ring-like fibro-cartilaginous pulley attached to the medial angular process of the frontal bone. This pulley (trochlea) should be defined and the tendon of the muscle followed laterally from it to its insertion on the eyeball. The levator palpebræ superioris is then to be raised from the surface of the underlying muscle, the **rectus superior,** and as this is done a nerve twig will be seen emerging from the rectus and entering its deep surface; it is a branch of the oculo-motor nerve.

The **superior oblique** muscle arises from the roof of the orbit just above the medial part of the optic foramen and passes forwards along the upper part of the medial wall. It ends in a slender, rounded tendon

which passes through a fibro-cartilaginous pulley (trochlea), and then turns laterally and backwards under cover of the superior rectus muscle. The tendon expands somewhat and is inserted into the eyeball behind its equator and beyond the lateral edge of the superior rectus. The pulley through which the tendon passes is lined by a synovial sheath.

The **trochlear nerve** is entirely expended in the supply of the superior oblique muscle. It enters the orbit from the lateral wall of the cavernous sinus through the sphenoidal fissure, and passes forwards under the periosteum to the surface of the back part of the muscle into which it sinks.

On the lateral side of the orbit the **lachrymal gland** will be exposed from above close to the orbital margin. It has already been examined from the front (p. 8), but its partial separation into two parts by the expanded tendon of the levator palpebræ superioris will now be more distinctly seen. Running along the lateral wall of the orbit to the gland, the **lachrymal nerve** and **artery** are to be found; they lie just above the upper border of the **lateral rectus** muscle.

The **frontal** and **lachrymal nerves** are two of the three terminal branches of the ophthalmic division of the trigeminal nerve; the other, the **naso-ciliary nerve**, will be secured later. They enter the orbit through the sphenoidal fissure, the ophthalmic nerve being divided before it reaches the orbit, and proceed forwards through the cavity, close to its roof, to their cutaneous distribution on the forehead and scalp.

The **frontal nerve** (Fig. 42) runs forwards on the upper surface of the levator palpebræ and ends at a variable point by dividing into supraorbital and supratrochlear branches. The **supraorbital** nerve continues in the line of the parent stem and passes through the supraorbital notch on to the forehead and the front of the scalp where it is distributed (p. 19). It is often divided into two parts before it leaves the orbit and then the larger lateral branch occupies the supraorbital notch. The **supratrochlear** nerve, smaller than the supraorbital, runs forwards and medially towards the trochlea of the superior oblique muscle. Passing above the trochlea, it turns round the orbital margin and is distributed on the medial part of the forehead (p. 19). In the orbit it communicates with the infratrochlear branch of the naso-ciliary nerve.

The **lachrymal nerve** (Fig. 42) is a slender branch which runs along the lateral wall of the orbit above the upper border of the lateral rectus muscle. It then passes under cover of the lachrymal gland, to which it gives numerous twigs, and enters the lateral part of the upper eyelid in which it ends.

The **levator palpebræ superioris** is a thin, flat muscle which arises by a narrow pointed tendon from the roof of the orbit above and in front of the optic foramen. In the anterior part of the orbital cavity it ends in a broad membranous expansion, the insertion of which into the upper eyelid has already been examined (p. 6). Its nerve is a branch of the superior division of the oculo-motor nerve and enters its deep surface after piercing the rectus superior muscle.

The **frontal** nerve and the levator palpebræ **muscle are** to be divided **about** their middle parts and turned **backwards and** forwards. The **superior rectus** muscle will be fully exposed.

The **superior rectus** arises from the upper margin of the optic foramen

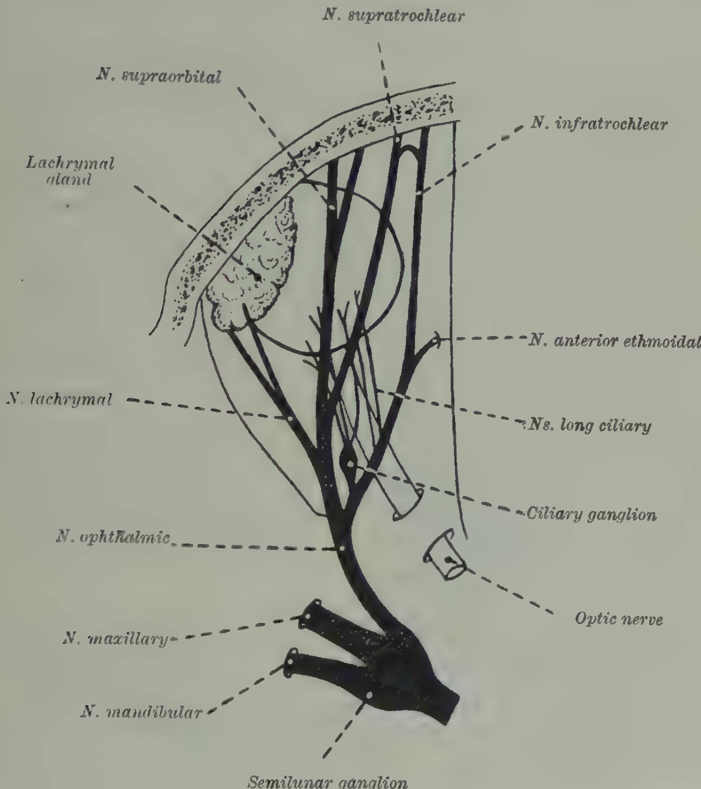


FIG. 42.

*Scheme of the ophthalmic nerve and its branches.*

and ends in front in a delicate tendinous expansion which is inserted into the eyeball a short distance behind the corneo-sclerotic junction.

The superior rectus is to be divided midway between its attachments and the two parts of the muscle are to be **reflected.** Entering the deep surface of the posterior part there will be seen the **superior division** of the **oculo-motor nerve** which supplies it

and the levator palpebræ superioris. The **optic nerve** is then to be brought into view by carefully removing the fat which covers it. It enters the orbit through the optic foramen, carrying with it a loose sheath of dura mater and coverings of the arachnoid and pia mater. It inclines laterally and slightly downwards as it passes forwards to the back of the eyeball, which it pierces a little on the medial side of its centre point. As the nerve is being exposed, there are to be secured, as they cross its posterior part, the **naso-ciliary nerve**, the **ophthalmic artery**, and the **superior ophthalmic vein**. The naso-ciliary nerve is to be cleaned in a forward direction. It passes along the medial wall of the orbit below the superior oblique muscle and divides into two terminal branches, the **infratrochlear** and **anterior ethmoidal** nerves, which are easily secured (Fig. 42). As it crosses the optic nerve it gives off two or three delicate twigs, the **long ciliary** nerves; they run along the optic nerve to reach the eyeball, within which they are distributed. These nerves, however, may not be found, but the **short ciliary** nerves which accompany them, and are much more numerous, can be readily secured. One of these nerves should be picked up and carefully followed backwards, for it will lead the dissector to the **ciliary ganglion**, a minute body which lies on the lateral side of the back part of the optic nerve (Fig. 42). The ganglion should be isolated and, with the exercise of a little care, its connections with the naso-ciliary nerve and the inferior division of the oculomotor nerve can be demonstrated.

The **naso-ciliary** nerve usually separates itself from the ophthalmic division of the trigeminal nerve in the anterior part of the cavernous sinus (Fig. 42). It enters the orbit through the sphenoidal fissure at a lower level than the frontal and lachrymal nerves, passing between the two heads of origin of the lateral rectus muscle. Running forwards, it inclines medially across the optic nerve and reaches the medial wall of the orbit between the superior oblique muscle above and the medial rectus muscle below. It divides there into its two terminal branches, the anterior ethmoidal and the infratrochlear nerves. The **anterior ethmoidal** nerve leaves the orbit by passing into the anterior ethmoidal foramen through which it enters the cranial cavity at the lateral border of the cribriform plate of the ethmoid bone. It crosses the cribriform plate under the dura mater and runs through a slit at the side of the crista galli into the nasal cavity, where it lies in a groove on the deep surface of the nasal bone. It gives off **internal nasal** branches to the mucous membrane of the nose, and continuing downwards emerges between the lower margin of the nasal bone and the lateral cartilage of the nose as the **external nasal** nerve. This nerve was secured and its distribution described in the dissection of the face (p. 19). There is a small **posterior ethmoidal** nerve which passes through the posterior ethmoidal foramen and gives twigs to the ethmoidal and sphenoidal air sinuses. It is not

probable that it will be found. The **infratrochlear** nerve runs along the medial wall of the orbit, and after passing under the trochlea of the superior oblique muscle it escapes from the orbit at the medial angle of the eye and supplies the skin of the eyelids and the side of the nose. The **long ciliary** branches have already been mentioned.

The **ciliary ganglion** (Fig. 42) is a small, flattened body of reddish

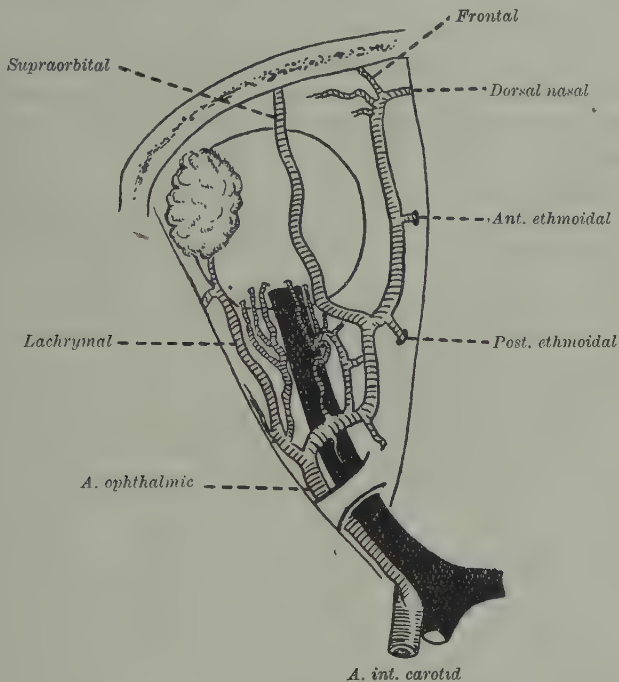


FIG. 43.

*A scheme of the ophthalmic artery and its branches.* The ciliary branches have not been named. The optic nerve is in solid black.

colour about the size of a pin's head. It is situated in the back part of the orbit in some loose fat on the lateral side of the optic nerve and commonly on the lateral side of the ophthalmic artery. Its posterior border receives three small twigs (or roots) which connect it to the naso-ciliary nerve, the branch of the oculo-motor nerve to the inferior oblique muscle, and the sympathetic plexus on the internal carotid artery. Its branches are the **short ciliary** nerves, six to ten in number. They arise from the front of the ganglion in two groups, superior and inferior, the lower nerves being the more numerous. They run forwards, one set above and one set below the optic nerve, and dividing in their course they pierce the eyeball round the entrance of the optic nerve.

The **ophthalmic artery** is now to be followed out, but it is seldom in an ordinary dissection that its numerous small branches can be satisfactorily displayed. It itself is a branch of the internal carotid artery and accompanies the optic nerve into the orbit through the optic foramen (Fig. 43). At first it lies below the nerve, but in the orbit it winds round its lateral side and crosses obliquely over it to reach the medial orbital wall. It then passes horizontally forwards below the superior oblique muscle and ends by dividing into two terminal branches, the frontal and the dorsal nasal arteries (Fig. 43). The other branches are very numerous.

The **frontal** artery accompanies the supratrochlear nerve to the forehead where it has already been dissected (p. 26). The **dorsal nasal** branch leaves the orbit above the medial palpebral ligament and is distributed over the root of the nose. The **central artery** of the **retina**, a small twig, is the first to be given off. It runs for a short distance within the dural sheath of the optic nerve, but about half an inch behind the eyeball it pierces the under surface of the nerve and runs forwards in its substance to the retina. The **lachrymal** artery, one of the larger branches, arises close to the optic foramen and runs forwards with the lachrymal nerve. It supplies the lachrymal gland and terminates by giving a branch, the **lateral palpebral** artery, to each of the eyelids (p. 8). **Muscular** branches are given to the muscles of the orbital cavity. The **ciliary** arteries are very numerous. They are arranged in two groups. The **anterior** ciliary arteries, six to eight in number, spring from the muscular branches and run to the anterior part of the eyeball where they form an arterial circle under the conjunctiva. They then pierce the eyeball a short distance from the corneo-sclerotic junction. The **posterior** ciliary arteries accompany the ciliary nerves, passing forwards with them and piercing the eyeball round the entrance of the optic nerve. The **supraorbital** artery leaves the ophthalmic artery after that vessel has crossed the optic nerve and accompanies the supraorbital nerve to the forehead. It was secured there in the dissection of the face and traced to its distribution on the anterior part of the scalp (p. 26). There are two **ethmoidal** arteries, anterior and posterior, which leave the orbit through the anterior and posterior ethmoidal foramina. The posterior is a small vessel which supplies the mucous membrane of the posterior ethmoidal air sinuses and of the upper part of the nose. The anterior artery, a larger vessel, accompanies the anterior ethmoidal nerve. In its course it gives off branches to the anterior ethmoidal and frontal air sinuses and the small anterior meningeal artery, which leaves it while it lies in the cranial cavity; and it terminates in branches to the nasal mucous membrane and one which appears on the dorsum of the nose between the nasal bone and lateral nasal cartilage.

The **ophthalmic veins** are two in number and are among those which are devoid of valves in their interior. They are difficult to dissect unless they have been specially injected. The superior vein is the larger. It accompanies the ophthalmic artery, commencing at the root of the nose where it communicates with the

angular vein of the face, and in its course receives tributaries corresponding more or less to those of the artery. The inferior ophthalmic vein begins on the floor of the orbit and runs backwards below the optic nerve, communicating with the pterygoid venous plexus in its course. The two ophthalmic veins pass between the two heads of the lateral rectus muscle and through the medial part of the sphenoidal fissure and open into the cavernous sinus either separately or by a common trunk.

The dissector will have noticed by this time a thin loose membranous tissue round the back part of the eyeball. This is the **fascia bulbi** (capsule of Tenon), and if it be grasped and a small

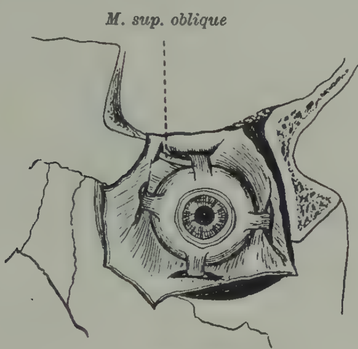


FIG. 44.

*The insertion of the ocular muscles from the front.* The conjunctiva and capsule of Tenon have been reflected from the front of the eyeball.

piece of it cut away, a space between it and the eyeball will be opened into. It is, therefore, a sort of synovial sac which envelops the eyeball, separating it from the orbital fat and forming a socket in which it is easily moved.

The **fascia bulbi** (capsule of Tenon) invests the whole of the eyeball except the cornea. It fuses with the sheath of the optic nerve behind and it ends in front by blending with the conjunctiva close to the margin of the cornea. The internal surface of the fascia is smooth and is connected to the eyeball only by some delicate areolar tissue. It is perforated behind by the ciliary vessels and nerves and in front by the tendons of the ocular muscles, on each of which it is reflected backwards as a tubular sheath. The sheaths of the medial and lateral recti muscles give off strong expansions which are attached to the lachrymal and malar bones respectively; as they probably check the action of these muscles they have been named the "check ligaments." The lower part of the fascia is thickened and is described to be slung like a hammock below

the eyeball which it supports; it has been named the "suspensory ligament of the eye."

The relations of the fascia with the tendons of the ocular muscles can be easily demonstrated from the front (Fig. 44). The eyelids should be cut away so as to expose as much as possible of the anterior face of the eyeball. The conjunctiva is then to be divided by a circular incision just behind the margin of the cornea, and as the fascia bulbi is fused with the conjunctiva it

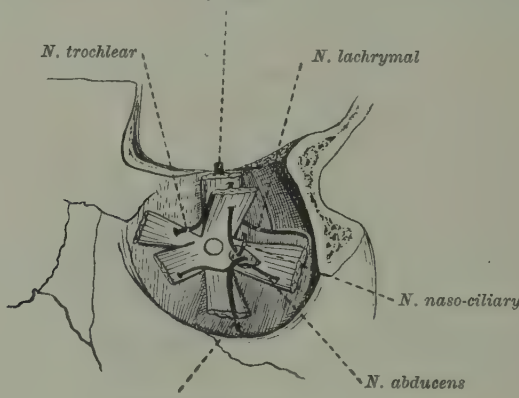


FIG. 45.

*A diagram to show the origin of the recti muscles round the optic foramen.* Note the two heads of the lateral rectus, and the group of nerves between them; the upper division of the oculo-motor nerve is not named. The other orbital nerves enter the orbit above the muscles. The muscles shown are the four recti, the superior oblique, and the levator palpebræ superioris.

is divided at the same time. If the conjunctiva and the fascia be then raised from the eyeball the openings in the fascia for the tendons of the four **recti muscles** will be seen; and it will be noted that the edges of the openings over which the tendons play are thickened to act as pulleys for them (Fig. 44).

The four **recti muscles** take origin at the apex of the orbit and proceed forwards, one above, one below, and one on each side of the eyeball. Each ends in front in a delicate expanded tendon which pierces the fascia bulbi and is inserted into the eyeball about a quarter of an inch behind the corneo-sclerotic junction. The origins of the muscles will be seen if the optic nerve be cut

and the ophthalmic artery and veins be cleared away and the eyeball pushed forwards.

The four **recti muscles** have a continuous tendinous origin in the form of an oval ring round the optic foramen (Fig. 45). The **superior** rectus thus takes origin from above the foramen, while the **medial** rectus springs from its medial margin. The **inferior** rectus arises from a fibrous band which bridges the medial end of the sphenoidal fissure; but the **lateral** rectus differs from the others in having two heads. The upper of these heads arises with the superior rectus and the lower with the inferior rectus, so that when they have fused to form the belly of the muscle they span the sphenoidal fissure; and through the arch between them pass the ophthalmic veins and the oculo-motor, the naso-ciliary, and the abducent nerves (Fig. 45).

The **abducent nerve** is to be followed forwards on the ocular surface of the lateral rectus muscle, in the supply of which it is expended; and then the **oculo-motor nerve** should be examined. It enters the orbit in two divisions, the superior of which has already been traced to the superior rectus and the levator palpebræ superioris muscles. The inferior and larger division breaks into three branches which supply the inferior rectus, the medial rectus, and the inferior oblique muscles, the branch to the oblique muscle being connected to the ciliary ganglion.

It can now be demonstrated that the nerves which were dissected in the cavernous sinus enter the orbit through the sphenoidal fissure in two groups (Fig. 45). The lachrymal, frontal, and trochlear nerves enter above the origin of the ocular muscles while the two divisions of the oculo-motor, the naso-ciliary and abducent nerves pass between the two heads of the lateral rectus muscle (Fig. 45).

The **inferior oblique** muscle remains to be examined. It is situated below the eyeball, and is best dissected from the front. The lower lid being removed, the eyeball should be raised from the floor of the orbit; a little blunt dissection and the removal of some fat will bring the muscle into view.

The **inferior oblique** muscle arises from a slight depression on the orbital surface of the maxilla just within the medial part of the orbital margin and close to the opening of the naso-lachrymal duct. It passes laterally and slightly backwards below the inferior rectus and ends in a tendinous expansion which is inserted into the eyeball under cover of the lateral rectus, and further back than the insertion of the superior oblique muscle.

The eyeball should be removed from the orbit by cutting the muscles. It is to be retained for purposes of comparison in the next dissection. The origin of the ocular muscles round the optic

foramen can now be more carefully examined and the entrance of the ocular nerves in two groups clearly defined.

## DISSECTION OF THE EYEBALL

The general anatomy of the eyeball is to be studied on the eye of the ox,[1] as it is difficult to obtain the human eye in a sufficiently recent condition for dissection. It should be noted, however, that the eye of the ox differs from the human eye not only in its larger size, but also in the following particulars: (1) the cornea is oval instead of being circular; (2) the pupil is elongated into a slit instead of being a round opening; (3) in the choroid coat there is a layer of peculiar colour, the tapetum, which is absent in man; and (4) the macula lutea (yellow spot) which is present in the human retina is absent in the eye of the quadruped.

The eye of the ox is usually obtained with remnants of the ocular muscles and part of the conjunctiva and capsule of Tenon (fascia bulbi) attached to it, and it is often embedded in a considerable amount of fat. The **optic nerve** is to be isolated from the surrounding fat and followed to the point where it perforates the **sclerotic**, and then the fat and the remnants of the muscles and the redundant conjunctiva are to be removed with scissors, so that the surface of the eyeball is cleanly exposed. While this is being done the dissector should secure, if possible, the **venæ vorticosæ**, four or five in number, which perforate the sclerotic a little posterior to the equator of the eyeball, and also the **posterior ciliary arteries** and the **ciliary nerves** which pierce it round the entrance of the optic nerve. The eyeball can now be seen to be nearly globular in shape, and appears to consist of two parts, an anterior clear part, the **cornea**, and a posterior opaque part, the **sclerotic**; and these two parts are segments of spheres of different radii, the cornea being curved more than the sclerotic.

Before the dissection of the eyeball is commenced, the dissector should study Fig. 46, an antero-posterior section of the human eyeball, and so obtain a general conception of the parts of which it is formed.

The eyeball consists of a wall of three coats which enclose within them certain refracting media (Fig. 46). The coats are: (1) an external fibrous coat, composed of a posterior white opaque part, the **sclerotic**, and an anterior clear, transparent

[1] The eye should be about three days old when it is dissected.

part, the **cornea**; (2) an intermediate vascular layer, black in colour, named the **choroid**; and (3) an internal nervous layer, the **retina**. The choroid coat may be subdivided into three parts: a posterior part, the **choroid proper**, which lies deep to the sclerotic; a thickened part, the **ciliary body**, which lies close to the corneo-sclerotic junction; and an anterior part, the **iris**, which lies horizontally behind the cornea, and in which there is the central aperture of the **pupil** (Fig. 46). The refracting media are: (1) the

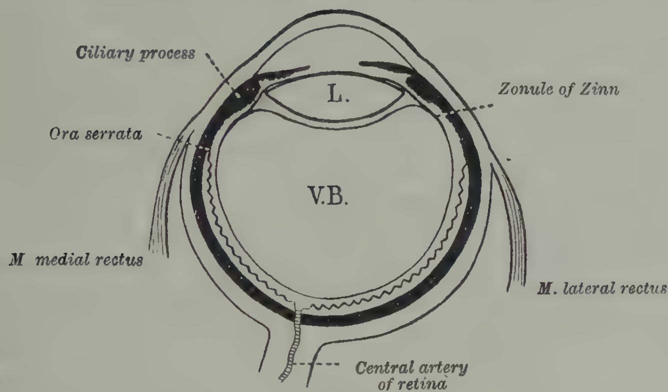


FIG. 46.

*Diagram of an antero-posterior section of the eyeball.*

L. Crystalline lens. V.B. Vitreous body.

The different parts of the three coats of the eyeball should be named. The choroid coat is in solid black, and the retina is a waved line; note how it is carried, as a notched margin, on to the ciliary processes and the back of the iris.

**crystalline lens**, which lies behind the iris; (2) the **aqueous humour**, a watery fluid, which fills the space between the cornea and the lens; and (3) the **vitreous body**, which occupies the cavity behind the lens (Fig. 46).

The surface of the sclerotic and the cornea should now be examined. The **sclerotic** is what is commonly known as the "white of the eye." It is a dense, opaque, fibrous-tissue layer, which forms the posterior five-sixths of the outer coat of the eyeball. It is pierced posteriorly, about one-eighth of an inch (in the human eye) on the medial side of its centre point by the optic nerve. There the dura mater sheath which envelops the nerve, and which is easily demonstrated in the human eye, blends

with the sclerotic, and the bundles of nerve fibres pass through a number of small openings. This perforated portion of the sclerotic is named the **lamina cribrosa.** A thin layer of sclerotic should be sliced off over the entrance of the optic nerve and the lamina cribrosa examined with a hand-lens; the bundles of nerve fibres can be seen, and in the centre of the nerve the **central artery of the retina** can be distinguished. Anteriorly the sclerotic tissue is directly continuous with that of the cornea at the **corneo-sclerotic junction**, and it is to be noted that as seen from the front the sclerotic tissue slightly overlaps the corneal tissue; the line of union, therefore, when seen in section, is oblique (Fig. 47). The **cornea**, clear and transparent in life, forms the anterior sixth of the outer coat of the eyeball. Its curvature is greater than that of the sclerotic. Its anterior surface is clothed by a continuation of the conjunctiva which becomes reduced, at its margin, to a thin, transparent epithelial layer.

The sclerotic is to be divided into two parts by a circular incision round the equator of the eyeball. A very sharp knife should be used at first and a small incision made through the sclerotic, layer by layer, until the subjacent black choroid coat is almost reached. The cut edge of the sclerotic should be grasped with forceps and one blade of a pair of scissors introduced beneath it; by keeping the point of the blade close against its deep surface it is now an easy matter to complete the division of the sclerotic without injury to the choroid. The posterior part of the sclerotic is to be reflected from the choroid, to which it is only very loosely attached by some pigmented trabecular tissue named the **lamina fusca**; at the entrance of the optic nerve, however, the two layers are closely connected, and the fibres of the nerve have to be cut through to complete the separation. On the half-sphere of the sclerotic which is now detached, it is to be noted that this layer is thickest posteriorly and becomes thinner as it passes forwards; near the cornea, however, it becomes thicker again owing to accessions of fibres from the tendons of the ocular muscles (Fig. 46).

The eyeball, on which the outer surface of the **choroid** proper is now exposed, should be immersed in water. As already described, the choroid is the posterior part of the vascular coat of the eyeball and is laden with pigment. It lines the deep surface of the sclerotic to which it is only loosely adherent, except behind where it is pierced by the optic nerve. In the interval between the two layers, the posterior ciliary arteries and nerves pass forwards to the ciliary body, and may be seen as delicate white filaments

on the surface of the choroid if it be carefully brushed (under water) with a camel-hair brush.

The **choroid** is composed of blood vessels arranged in two layers, a deep layer of closely meshed capillaries (lamina chorio-capillaris) and a superficial layer of larger vessels of which the venæ vorticosæ are the chief; these veins may be seen as white lines converging to the main trunks which pierce the sclerotic, if the pigment be washed out of the choroid. In the eyes of many mammals, but not in man, there is a brightly coloured layer in the choroid named the tapetum: in the ox it is brilliant green in colour.

The **ciliary nerves** are branches of the ciliary ganglion and of the naso-ciliary nerve. They pierce the sclerotic round the entrance of the optic nerve, and pass forwards between the sclerotic and choroid to the region of the ciliary processes, where they break into branches which supply the ciliary muscle and the iris. In the posterior part of the eyeball they lie in grooves on the deep surface of the sclerotic. The **ciliary arteries** are all branches of the ophthalmic artery, but they may be arranged in three groups according to their distribution. (1) The short posterior ciliary arteries pierce the sclerotic round the optic nerve and are distributed in the choroid coat. (2) The long posterior ciliary arteries, two in number, perforate the sclerotic one on each side of the optic nerve, and pass forwards between the sclerotic and the choroid to the ciliary region. There they form an arterial circle with (3) the anterior ciliary arteries, small twigs which pierce the sclerotic close to the corneal junction. Branches are given off from this circle to the ciliary body and the iris.

The deep surface of the choroid is moulded on the **retina**, but in a dissection such as the student is making little of the details of this layer can be made out; he must supplement his dissection with the examination of museum specimens. The retina is composed of two layers, an external **pigmented layer**, which is very thin and which adheres to the deep surface of the choroid, and an internal **nervous layer** in which the optic nerve spreads out. An attempt should be made to strip off the choroid (under water), and to expose, at least in part, a thin, grey, opaque membrane which is the retina proper; in life it is transparent, but it becomes opaque soon after death. In favourable circumstances branches of the **retinal artery** and **vein** will be seen ramifying in it.

The **retina** lies deep to the choroid to which its pigmented layer is adherent, and is moulded on the surface of the vitreous body from which, however, it is perfectly free except at the entrance of the optic nerve. The retina appears to end a short distance in front of the equator of the eyeball in a notched margin named the ora serrata; but though the nervous elements do not extend beyond this line, a thin pigmented lamina, representative of the retina, is prolonged over the ciliary body and on to the back of the iris (Fig. 46). These parts are named the pars ciliaris and the pars iridica of the retina. The optic nerve enters the retina proper on the medial side of its centre point, and when seen from the front appears as a conspicuous whitish disc, named the optic

disc ; in the centre of the disc there is a slight hollow, which is termed the optic cup. At the centre point of the retina, and therefore on the lateral side of the optic disc, there is a small oval yellowish spot, the macula lutea, and in its centre a slight depression, the fovea centralis. The **central artery** of the retina enters the retina in the middle of the optic disc and immediately divides into an upper and a lower branch. These ramify in the retina as far as the ora serrata. The **retinal veins** accompany the branches of the artery, and converging towards the optic disc, form two trunks which pass into the substance of the optic nerve.

The **vitreous body** enclosed in the **hyaloid membrane**, and carrying with it the **crystalline lens** in its **capsule**, should now be shaken out of the anterior part of the eyeball. It should be allowed to drop into a vessel filled with water, well tinted with picro-carmine, and when it is sufficiently stained it should be removed to clear water.

In the anterior part of the eyeball, the **ciliary body** and the **iris** can be examined from behind, the specimen being looked at under water.

The **ciliary body** is a thickened part of the vascular coat. It is thrown into a series of folds, the **ciliary processes**, about sixty to eighty in number in the human eye; they are seen in the specimen, radially arranged, forming a sort of frill behind the iris, and jet black in colour. The processes are continuous with the choroid behind. As they extend forwards they become more prominent, and close to the peripheral margin of the iris they terminate in rounded ends. The edges of the processes are attached to the suspensory ligament of the lens, and the lines of attachment are usually quite distinctly marked on the hyaloid membrane as a circle of radiating lines just beyond the periphery of the lens.

The **ciliary processes** are similar in structure to the choroid. Their inner surfaces are covered by the pars ciliaris retinæ, which comprises the outer pigmented layer of the retinæ proper and the epithelial continuation forwards of the nervous layer.

The **ciliary muscle** which lies in the ciliary body cannot be defined in an ordinary dissection, though its general position and relations will be examined afterwards (p. 149). It is composed of involuntary muscular fibres, arranged in two groups. (1) The radiating fibres arise from the deep surface of the sclerotic close to the corneal margin and pass backwards to be inserted into the ciliary processes (Fig. 47). This part of the muscle is the chief agent in effecting "accommodation of the eye"; when it contracts it will draw forwards the ciliary processes and with them the suspensory ligament of the lens, which is thus relaxed and allows the lens to become more convex. (2) The circular fibres lie on the deep surface of the radiating fibres; they are over-developed in "long-sighted" eyes but are rudimentary or absent in "short-sighted" eyes.

The cornea is now to be cut through from the front all the way round, close to the corneo-sclerotic junction, so that when it is lifted away the **iris** can be examined from the front as well as from behind. On the posterior surface of the detached piece of the cornea, an elastic layer, the **posterior elastic lamina** (of Descemet),

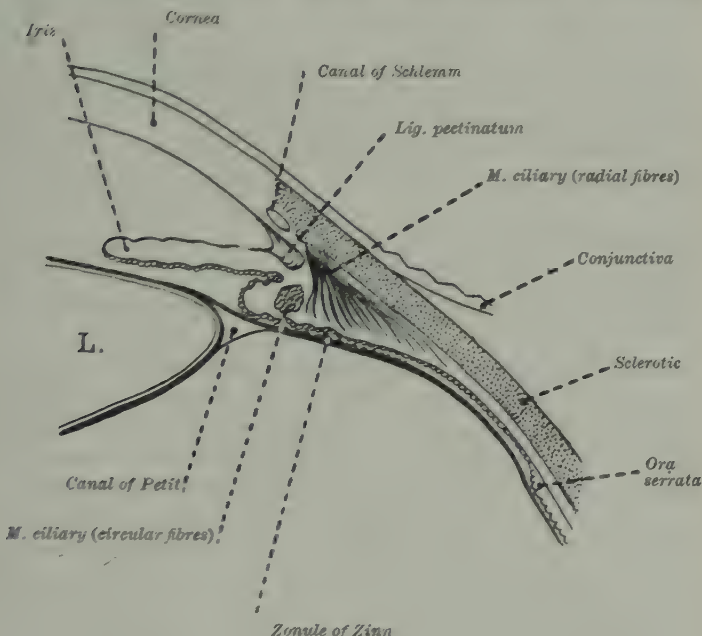


Fig. 47.

*Diagram of the corneo-sclerotic junction.* The hyaloid membrane and the retina should be named and carefully studied in a forward direction. The anterior and posterior chambers of the eye and the spaces of Fontana should be labelled. L, the lens, enclosed in its capsule.

is to be looked for; it will probably have become wrinkled and can then be torn away in shreds from the cornea. At the peripheral margin of the cornea this lamina becomes broken up and fibrillar, and some of its fibres are reflected on to the anterior surface of the iris, forming the **ligamentum pectinatum** (Fig. 47); between the bundles of fibres there are recesses which are known as the **spaces of Fontana**.

The iris is a circular contractile diaphragm perforated in its

centre by the **pupil**, the size of which is constantly varying during life to control the amount of light admitted to the retina. The circumference of the iris is continuous with the ciliary body. Its posterior surface lies immediately in front of the lens and is deep black in colour, being covered by the pars iridica retinæ. Its anterior surface is faintly striated in a radial direction, and in colour may range from dark brown to light blue in different individuals. The iris divides the space between the cornea and the lens into an **anterior chamber** and a **posterior chamber**, the latter being only a narrow chink behind the iris and in front of the ciliary processes and the suspensory ligament of the lens; the two chambers communicate with one another through the pupil.

The movements of the iris are produced by the involuntary muscle fibres which are to be found in its substance. They are arranged in two groups. One group is composed of fibres arranged circularly round the pupil in the form of a sphincter, while the other group consists of fibres which have a radial direction and would, therefore, dilate the pupil.

The **vitreous body** should now be examined. It is a transparent, soft, jelly-like body which occupies the interior of the eyeball behind the lens. It is enclosed within a delicate transparent membrane, named the **hyaloid membrane**, which, however, is strong enough to allow it to be handled with considerable freedom.

Running forwards through the vitreous from the entrance of the optic nerve to the posterior surface of the lens, there is a minute canal, the **hyaloid canal**, lined by a prolongation of the hyaloid membrane. It cannot be seen, however, unless the vitreous is specially stained. In the fœtus a branch of the central artery of the retina passes along the canal to the capsule of the lens, but it afterwards disappears.

In the region of the ciliary processes the hyaloid membrane is thickened by an accession of radial fibres. This thickened part is named the **zonule of Zinn**, and to it the ciliary processes are attached, as is shown by the pigmented markings on the zonule after it has been removed from them. As it approaches the margin of the lens the zonule splits into two layers (Fig. 47). The posterior of these is very delicate and, lining the depression in which the lens is placed, encloses the vitreous in front, while the anterior stronger part, the **suspensory ligament** of the **lens**, is attached to the anterior surface of the capsule of the lens a short distance beyond its equator (Fig. 47). Scattered fibres are also attached to the region of the equator itself. The ligament of the lens retains the lens in position and would be relaxed by the contraction of the radiating fibres of the ciliary muscle.

The point of a very finely drawn glass tube, with an india-rubber tube fixed to it, is to be inserted through the suspensory ligament of the lens. There can then be inflated a space, the **canal of Petit**, which surrounds the circumference of the lens. It lies between the anterior and posterior layers of the ligament, and when inflated presents a sacculated appearance.

The **crystalline lens** is a solid, transparent, biconvex structure enclosed within an elastic capsule to which the suspensory ligament is firmly attached. The anterior wall of the capsule, which is thicker than the posterior wall, should be scratched with the point of a sharp needle, after which a little pressure will cause the lens to escape through the opening. The capsule of the lens can then be very well examined, while on the lens itself it is to be noted that the anterior surface is not so highly curved as the posterior surface. If it be compressed between the finger and the thumb, it can be determined that the outer cortical part of the lens is soft and that the central nuclear part is distinctly firmer.

The hyaloid membrane is then to be punctured with blunt forceps, so that the jelly-like consistence of the escaping vitreous may be appreciated.

A section of the corneo-sclerotic junction is then to be made and the surface examined with a hand-lens (Fig. 47). The **ciliary muscle** may be seen on it as a greyish, semi-transparent band on the outer surface of the ciliary processes. It is thickest at its anterior part. In the substance of the sclerotic, close to the corneal junction and just external to the ligamentum pectinatum, there is a small cleft; this is a section of a circular canal, the **canal of Schlemm**.

## DISSECTION OF THE EAR

The organ of hearing can be very naturally subdivided into three parts (Fig. 48). (1) The **external** ear consists of the auricle and the external auditory meatus. The auricle collects the waves of sound which are then conducted along the meatus to the **membrana tympani** ("the drum of the ear"), which closes the inner end of the meatus and separates it from the middle ear. (2) The **middle** ear is an irregular air-filled space within the temporal bone. This space comprises a narrow central part, the **tympanic cavity**, which lies deep to the tympanic membrane and into which a needle would pass if pushed through the membrane. Stretching across the tympanic cavity, from the tympanic

membrane to its inner wall, there is a chain of three small bones, named the **auditory ossicles**; they serve to transmit the vibrations of the membrana tympani across the tympanic cavity to the internal ear. Opening out of the tympanic cavity behind, there is a further part of the middle ear, named the **tympanic antrum**, while leading into it in front there is the **Eustachian** (auditory) **tube** which opens at its other end into the upper part of the pharynx. The middle ear, then, comprises the tympanic cavity, the tympanic antrum, and the Eustachian tube. (3) The

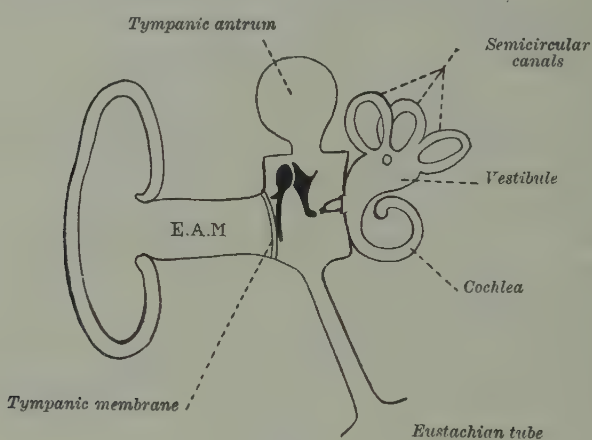


FIG. 48.

*Diagram of the auditory apparatus.* The auditory ossicles are shown in the tympanic cavity. E.A.M. External auditory meatus.

**internal** ear, the essential part of the organ of hearing, consists of a complicated system of cavities (the bony labyrinth) in the petrous part of the temporal bone. These bony cavities contain within them membrane-walled tubes (membranous labyrinth) of the same general shape as themselves, but only partially filling them; the membranous labyrinth contains a fluid named endolymph, while the space between it and the wall of the bony labyrinth is filled with a fluid called perilymph. The bony labyrinth consists of three parts: (1) an anterior part coiled spirally like a snail's shell, the **cochlea**; (2) a posterior part in the form of three **semicircular canals**; and (3) an intermediate oval part, the **vestibule**, into which the other two parts open.

The exposure of the different parts of the ear cannot be under-

taken in great detail in the course of an ordinary dissection. The student's aim should be to acquire by the simplest dissection a general knowledge of the arrangements of the parts, an appreciation of their size, and a clear picture of their important relations; the details can be studied afterwards on permanent specimens and on enlarged models.

The **auricle** (or pinna) has already been examined (p. 22). The tragus of the auricle should be cut away to expose the orifice of the **external meatus** which lies at the bottom of the concha. The anterior wall of the whole length of the meatus is then to be removed, the outer cartilaginous part with the knife and the inner


FIG. 49.

*The tympanic membrane as seen from without.* The handle of the malleus is very distinct, and behind it, less distinct, is the descending process of the incus. The membrana flaccida is bounded by the tympano-malleolar folds.

bony part with small bone forceps, so that the outer surface of the **tympanic membrane** is exposed.

The **external auditory meatus** is about an inch long from its orifice to the tympanic membrane. The outer third is the cartilaginous part and the inner two-thirds the bony part. The general direction of the meatus is towards the median plane with a slight inclination forwards, but it describes a gentle sigmoid curve in its course and a slight curve convexly upwards; it can be made almost straight, when it requires to be examined, by pulling the pinna upwards and backwards. The size and shape of the meatus are not uniform throughout. It is narrowest about a quarter of an inch from the tympanic membrane, and while its vertical diameter is greatest at the outer end the antero-posterior diameter is greatest at the inner end. The skin lining the cartilaginous part is provided with hairs directed to the orifice and is furnished with "wax-glands," but the lining of the bony part is thin, is without hairs or glands, and is closely attached to the bone; it is continued as a very thin layer over the outer surface of the tympanic membrane.

The **tympanic membrane** separates the external meatus from the tympanic cavity. It is not vertically placed but slopes obliquely from above downwards, inwards and forwards; so that the anterior wall and the floor of the external meatus are longer than the posterior wall and the roof. The tympanic membrane is concave when looked at from without, as is done in the examination of the living subject (Fig. 49). The deepest point of the concavity is named the umbo, and corresponds with the lower end of the handle of the malleus, one of the auditory ossicles, which is attached to the deep surface of the membrane and can be seen through it. From the umbo the handle of the malleus passes upwards and slightly forwards but stops a short distance from the edge of the membrane at a slightly bulged part, which is the projection caused by the lateral process of the malleus. Above this process there is a triangular area of the membrane thinner and less tense than the remainder. This is the membrana flaccida (Shrapnell's membrane), and it is limited in front and behind by relatively thickened folds, the anterior and posterior tympano-malleolar folds. The edge of the tympanic membrane, apart from the membrana flaccida, is embedded in the circular groove (sulcus tympanicus) at the inner end of the tympanic part of the temporal bone.

The auricle is now to be cut away and all the soft parts, including the periosteum, are to be removed from the surface of the mastoid region of the temporal bone. There should then be identified the **suprameatal crest** which passes backwards above the auditory meatus and is continued into the temporal line, and the **suprameatal triangle**, a small depressed area which lies above the postero-superior quadrant of the bony external meatus (Fig. 51). A horizontal saw-cut should now be made through the lateral wall of the skull at about the level of the upper surface of the petrous temporal bone, and a vertical cut should be carried down to meet it behind the region of the mastoid process. The part of the skull wall thus defined being knocked away, the dissector must turn to the upper (anterior) surface of the petrous temporal bone in the middle fossa of the skull, and carefully remove the **tegmen tympani** in thin shavings with a small chisel and a mallet. The tegmen has already been defined as the area of bone lateral to the eminentia arcuata. The **tympanic cavity** will now be opened from above, and the dissector should appreciate the thinness of the bone which separates the middle ear from the middle fossa of the skull; and he will understand that an intracranial extension of a chronic inflammatory condition of the middle ear is always to be feared. The removal of the tegmen tympani must be carried backwards till the **tympanic antrum** is also opened, and then in forward and lateral directions till the inner surface of the tympanic membrane can be distinctly seen. The **auditory ossicles** will have presented themselves, and as they must be removed to view

the tympanic cavity, they should be examined while still in position.

The auditory ossicles are three in number, and are named the **malleus**, the **incus**, and the **stapes** (Fig. 50). The large rounded head of the **malleus**, supported on a short neck, is easily recognised. It lies close beneath the tegmen tympani and, it should be noted, well above the level of the tympanic membrane. Extending downwards from the neck, to be attached to the tympanic membrane, is the handle of the malleus, and at its root is the stunted lateral process which abuts against the tympanic membrane immediately below the apical part of the membrana flaccida. Passing anteriorly from the neck to be fixed in the petro-tympanic (Glasserian) fissure

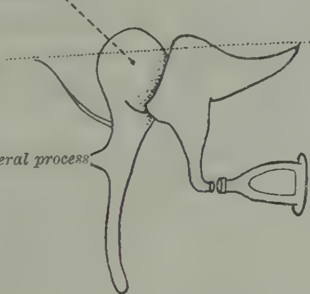


FIG. 50.

*The auditory ossicles.* The dotted line is the axis of movement.

there is a slender spicule of bone, the processus gracilis: it will break when the malleus is lifted out of the cavity. The **incus** is shaped like a tooth with two widely divergent fangs. The body of the bone articulates with the lower part of the back of the head of the malleus. The shorter of the two processes is directed backwards, and its extremity is attached by ligaments to the posterior wall of the tympanic cavity near the opening of the antrum. The longer process passes downwards and medially, nearly parallel with, but behind, and medial to the handle of the malleus, and its extremity, which is bent medially, articulates with the head of the stapes. The **stapes**, so named because it is shaped like a stirrup, articulates by its head part with the incus. The two crura, the posterior of which is the more curved, join the foot-plate or base; this part fits into the foramen vestibuli (or ovale), an opening on the inner wall of the tympanic cavity leading into the

vestibule of the bony labyrinth, and is fixed to its margin by ligamentous fibres.

The movements of these bones normally occur with the movements of the tympanic membrane. When the membrane moves inwards, carrying with it the handle of the malleus, the malleus and incus rotate together round an antero-posterior axis formed by the processus gracilis of the malleus and the posterior process of the incus. In this movement the descending crus of the incus moves medially, and the foot-plate of the stapes will therefore be pressed into the foramen vestibuli; and the original movement of the membrana tympani will be communicated to the perilymph in the bony labyrinth. The movements of the bones are reversed when the tympanic membrane moves outwards, but if the movement of the membrane is exaggerated, as may occur when the tympanic cavity is inflated through the Eustachian tube, the incus does not follow the malleus, for the joint between the two bones unlocks; the danger of pulling the foot-plate of the stapes out of the foramen vestibuli is thus avoided.

There are two small muscles attached to the auditory ossicles, one to the malleus, the **tensor tympani**, and one to the stapes, the **stapedius**. The details of their attachments cannot be studied in an ordinary dissection; both muscles are very small.

The **tensor tympani** arises from the upper part of the cartilage of the Eustachian tube and from the adjoining part of the great wing of the sphenoid bone, and passes backwards into a bony canal in the temporal bone. This canal lies above the osseous part of the Eustachian tube and is separated from it by a thin plate of bone, named the processus cochleariformis (Fig. 52). Entering the tympanic cavity from its canal, the tendon of the muscle turns at right angles round the posterior edge of the processus cochleariformis and passes laterally to be inserted into the upper part of the handle of the malleus. The muscle is supplied by the mandibular nerve through a branch from the otic ganglion.

The **stapedius** muscle arises from the wall of a conical cavity which opens on a small pyramidal eminence on the posterior wall of the tympanic cavity. Through this opening the delicate tendon of the stapedius passes into the tympanum and is inserted into the posterior surface of the neck of the stapes. It is supplied by a branch of the facial nerve.

The ossicles are now to be picked out of the tympanic cavity. The removal of the tegmen tympani is then to be carried forwards until the opening of the **Eustachian tube** and of the **canal for the tensor tympani** muscle are brought into view. The tympanic cavity, a common site of disease, is to be examined with great care.

The **tympanic cavity** is about half an inch in length and the same in its vertical depth, but from side to side it measures only about one-sixth of an inch; and as both its outer and inner walls bulge into it, its width in the centre is still further reduced. The

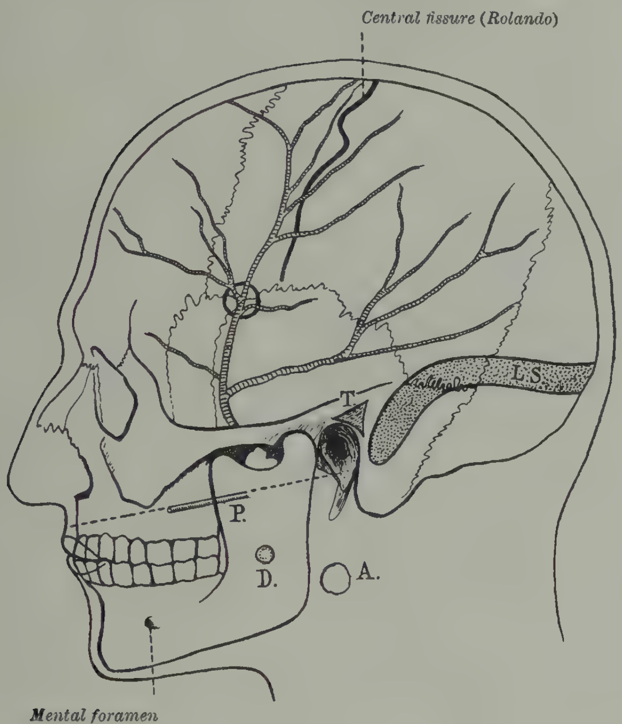


FIG. 51.

*A diagram of the surface markings of the head.* The middle meningeal artery and its anterior and posterior branches are shown.

L.S. Lateral sinus, note the position of its sigmoid part. T. Suprameatal triangle (of Macewen). P. Parotid duct, the line of which is shown. D. Inferior dental foramen. A. Position of the transverse process of the atlas.

cavity may be divided into two parts; the tympanic cavity proper, which lies opposite the tympanic membrane, and the attic, or **epitympanic recess**, which extends above the level of the membrane. The **roof** of the cavity, the tegmen tympani, has been removed. The **floor** is narrow and consists of a thin, convex plate of bone, which separates the tympanic cavity from the bulb of the internal jugular vein. In places the bone may be deficient, and the vein

would then be in contact with the mucous membrane lining the cavity. The **lateral wall** is formed mainly by the tympanic membrane, but above the membrane it is formed by the squamous part of the temporal bone (Fig. 48).

The **tympanic membrane** has already been described (p. 152), and it only remains to state that it is composed of three layers; namely, an external layer of thin skin, an intermediate fibrous layer to which the handle of the malleus is attached, and an internal covering of the mucous membrane of the tympanic cavity.

The **posterior wall** of the tympanic cavity has, in its upper part, the wide opening or **aditus** which leads from the epitympanic recess into the tympanic antrum. Below this opening, and close to the medial wall of the cavity, there is a small conical eminence named the **pyramid**; it is perforated on its summit, and transmits the delicate tendon of the stapedius muscle. The **tympanic antrum**, about one-third of an inch in diameter, is a cavity in the base of the petrous part of the temporal bone. It communicates in front with the tympanic cavity, and through its floor and posterior wall with the mastoid air cells, which vary considerably in number, size, and form (Fig. 52). The cells communicate with one another, and like the antrum are lined by a mucous membrane continuous with that of the tympanic cavity. The position of the antrum is to be very carefully examined. It lies at a depth of about half an inch from the surface, but is very variable in this respect; in the child it is nearer to the surface. On the surface its position is indicated by the supramental triangle (Fig. 51), and using the gouge the student must open the antrum through the triangle; the removal of the bone must be in a direction slightly forwards, parallel with the posterior wall of the bony external meatus. This is the route by which the surgeon enters the antrum in operating for the relief of middle ear disease. Another important relationship is with the sigmoid part of the lateral sinus. It lies behind the antrum and at a lower level (Fig. 51), but like the antrum its depth from the surface is very variable.

The **anterior wall** of the tympanic cavity is narrow. In the upper part of it there is the opening of the canal for the tensor tympani muscle, and below this is the wide tympanic orifice of the Eustachian tube (Fig. 52). The canal for the muscle is to be opened by the removal of the roof, which is the anterior part of the tegmen tympani; in this way the tensor tympani muscle may be exposed. The bony septum between the muscle canal and the Eustachian tube, the processus cochleariformis, is very

thin; its posterior end serves a pulley round which the tensor muscle passes laterally to the handle of the malleus (Fig. 52). Below the opening of the Eustachian tube the anterior wall is formed by a thin plate of bone which separates the tympanic cavity from the carotid canal (Fig. 52).

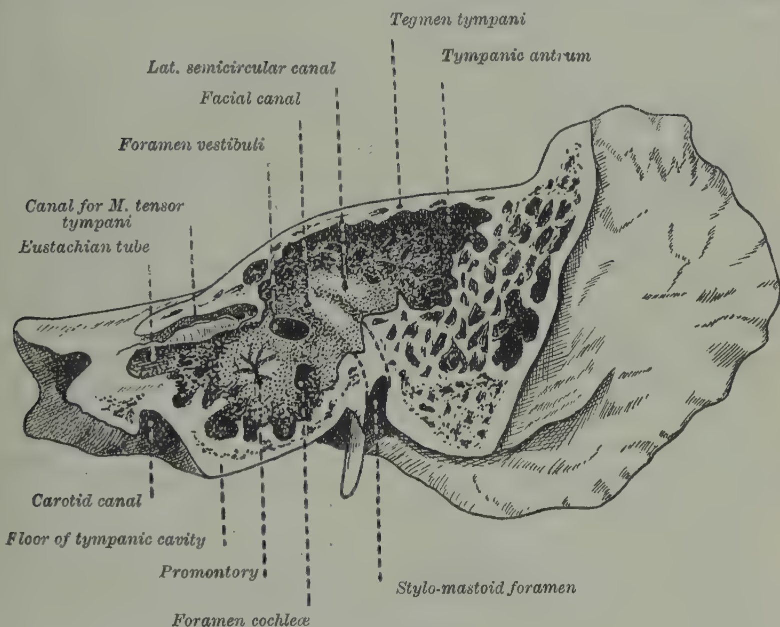


FIG. 52.

*Dissection of the middle ear from without.* The processus cochleariformis is the folded shelf of bone between the canal for the tensor tympani and the Eustachian tube. The descending part of the facial canal is indicated by broken lines. The mastoid air cells fill the mastoid process.

The **Eustachian** (auditory) **tube** is the passage through which the tympanic cavity communicates with the nasal part of the pharynx. It is directed forwards, downwards, and towards the middle line, and is about one and a half inches in length. It is formed partly of bone and partly of cartilage and fibrous tissue. The bony portion is about half an inch long. It is widest at its opening into the tympanic cavity and gradually narrows as it passes forwards immediately above the carotid canal, from which it is separated by a thin plate of bone. It ends in a jagged margin at the apex of the petrous part of the temporal bone, to which the cartilaginous part is attached. This portion will be dissected and described with the pharynx.

The **medial wall** of the tympanic cavity is now to be more fully exposed by removing the tympanic membrane and the posterior wall of the external meatus. It intervenes between the tympanic cavity and the internal ear, and on it there are certain important markings (Fig. 52). Over the greater part of the surface there is a rounded elevation named the **promontory**; it is produced by the projection outwards of the first turn of the cochlea. On its surface there may be seen small grooves for the lodgment of branches of the **tympanic plexus** of nerves. Behind the upper part of the promontory there is an oval foramen, the **foramen vestibuli** (or ovale), the long axis of which is directed antero-posteriorly; it opens into the vestibule, the intermediate part of the bony labyrinth, but in the recent state it is occupied by the foot-piece of the stapes. Below and behind the promontory there is a round opening, the **foramen cochleæ** (or rotundum), an aperture which leads into the cavity of the cochlea. In the recent state it is closed by a membrane which is named the **secondary tympanic membrane.** Above the foramen vestibuli, and lying in the angle at the junction of the roof and the medial wall, there is an antero-posteriorly directed prominence; it is the wall of the bony canal in which the facial nerve lies, the **facial canal** (or aqueduct of Fallopius) (Fig. 52). The wall of the canal is thin, and through it the white nerve can be seen.

The **mucous membrane** of the middle ear, pale and thin, is continuous with that of the pharynx through the Eustachian tube. It lines the walls of the tympanic cavity and invests the ossicles and the tympanic muscles, a series of folds thus being formed which divide the cavity into pouch-like spaces. From the tympanic cavity it is continued backwards as the lining of the antrum and the mastoid air cells.

The whole course of the **facial nerve** through the temporal bone should be studied at this stage of the dissection. With the auditory nerve, which lies below it, it has already been followed into the internal auditory meatus (p. 130). At the bottom of the meatus it enters the **facial canal** and in it passes through the bone to the stylo-mastoid foramen. The roof of the internal meatus must be chipped off with the chisel and mallet, and in it the facial and auditory nerves are to be defined. They run almost directly laterally, the facial nerve being uppermost; and its small sensory root, which lies between the two great nerves, joins it in this part of its course. At the bottom of the meatus the facial nerve pierces the upper and anterior part of the lamina cribrosa and enters the facial canal; and in it it first passes

laterally to reach the medial wall of the tympanic cavity. This part of the canal can be easily opened up. It will then be seen that this portion of the nerve is short, that it crosses over the internal ear in the interval between the cochlea and the vestibule (Fig. 48), and that at its termination there is a small ganglion on it, named the **geniculate ganglion.** Arising from this ganglion there can be readily found the **great superficial petrosal** nerve. It issues from the temporal bone through the hiatus canalis facialis on its upper surface; from there its further course was previously studied (p. 130). Also arising from the ganglion there are connecting branches to the tympanic plexus and to the small superficial petrosal nerve which arises from the plexus; these, however, will not be found, though the markings of the plexus on the promontory are usually to be seen (Fig. 52).

The facial nerve should now be followed backwards from the geniculate ganglion by opening the lateral wall of the facial canal. At the ganglion the nerve bends at right angles on itself and runs backwards on the medial wall of the tympanic cavity above the foramen vestibuli (ovale). At the level of the posterior wall of the tympanum the nerve turns downwards, the bend here being an open curve on the medial side of the pyramid and on the medial wall of the aditus (Fig. 52), and descends almost vertically to the stylo-mastoid foramen. As it turns downwards it gives off the nerve to the stapedius which enters the base of the pyramid and thus reaches the muscle. The vertical part of the nerve can be exposed by removing the necessary bone with a small saw and the bone forceps, and if the dissection be well made the **chorda tympani** will be seen taking origin from the nerve a short distance above the stylo-mastoid foramen.

The **chorda tympani** is the largest branch which arises from the facial nerve in its course through the temporal bone. From its origin near the stylo-mastoid foramen it runs in a minute canal through the bone and enters the tympanic cavity through a foramen (iter chordæ posterius) below the pyramid and close to the inner surface of the posterior part of the tympanic membrane. In the tympanic cavity it runs forwards across the upper part of the tympanic membrane, under cover of the mucous membrane but over the medial side of the handle of the malleus; it was destroyed, therefore, when the malleus was removed. It then passes above the tendon of the tensor tympani muscle and leaves the cavity through a foramen (iter chordæ anterius) at the inner end of the petro-tympanic (Glasserian) fissure and emerges on the exterior of the skull in the pterygoid region. There it was found to join the lingual nerve and its fibres were followed to the submaxillary ganglion and to the tongue. Its course in the temporal bone is difficult to follow unless the bone be decalcified, and should not be attempted by the student.

The different parts of the bony labyrinth of the **internal ear** can be displayed only by very careful and prolonged dissection; the student should demonstrate, therefore, only the main parts and their relations to one another, and on permanent specimens and enlarged models he should examine the details.

The **superior** of the **semicircular canals** is to be exposed by cutting away the eminentia arcuata in thin shavings with the chisel, and if it be followed backwards and forwards the size and shape of the canal and of its lumen will be defined. The **vestibule**


FIG. 53.

*The bony labyrinth of the internal ear from the lateral side.* Compare the positions of the lateral semicircular canal, the facial canal, the foramina vestibuli and cochleæ, and the first turn of the cochlea with the markings on the medial wall of the tympanic cavity (Fig. 52).

and the **cochlea** are then to be opened by chipping away the petrous temporal bone horizontally to about the level of the middle of the promontory; parts of the other semicircular canals will also be opened and their position and curves can be demonstrated by passing bristles into them.

The **vestibule** (Fig. 53) is a small ovoid cavity of about one-sixth of an inch in length and is situated between the medial wall of the tympanic cavity and the bottom of the internal auditory meatus. The three semicircular canals open into it posteriorly, while in its lower and anterior part there is the opening of the scala vestibuli of the cochlea. On the lateral wall of the vestibule there is the foramen vestibuli (ovale) which is occupied in the recent state by the foot-plate of the stapes, while on the medial wall there are several groups of small foramina through which the filaments of the auditory nerve pass to the membranous labyrinth. There is also to be found there the opening of the aqueductus

vestibuli, a small canal which passes backwards and opens on the posterior surface of the petrous bone.

The **semicircular canals** are three in number and are placed posterior to the vestibule in planes at right angles to each other, like three sides of a cube (Fig. 53). They are named from their position the superior, posterior, and lateral canals. Each canal forms considerably more than half a circle and opens by both ends into the back part of the vestibule; but since the adjoining ends of the superior and posterior canals are fused together in a common canal, the crus commune, the total number of openings is reduced to five (Fig. 53). One extremity of each canal is expanded into what is termed its ampulla. The superior canal forms the highest part of the labyrinth. It is vertical and placed almost at right angles to the long axis of the petrous part of the temporal bone, almost corresponding in position to the smooth elevation on its upper surface named the eminentia arcuata. The posterior canal is also vertical and lies in a plane parallel with the posterior surface of the petrous bone. The lateral canal lies in a horizontal plane; it produces a longitudinal elevation on the medial wall of the tympanic cavity above the facial canal (Fig. 52).

The **cochlea** (Fig. 53) has the form of a blunt cone, the base of which is turned towards the bottom of the internal auditory meatus while the apex is directed antero-laterally and is close to the canal for the tensor tympani muscle. It measures about one-fifth of an inch from base to apex and is about one-third of an inch broad at its base. The cochlea consists of a tapering tube which is coiled spirally for nearly two and three-quarter turns round a central pillar named the modiolus, the appearance produced being somewhat similar to that of a spiral shell. The modiolus, the central pillar of the cochlea, is thick at its base but tapers rapidly towards its apex. Its base appears at the bottom of the internal auditory meatus and entering it there are the filaments of the auditory nerve which are distributed to the membranous cochlea. The first turn of the cochlea is the widest part of the tube and has the most extensive curve; it produces the elevation of the promontory on the inner wall of the tympanic cavity. The closed end of the tube is named the cupola. The tube is partially subdivided by a thin projecting shelf of bone (the lamina spiralis) which winds spirally round the modiolus like the thread of a screw; and in the recent state the subdivision into two passages is completed by the membranous cochlea which is placed between the free margin of the spiral lamina and the opposite wall of the osseous tube. The two passages into which the bony tube is thus divided are named the scala vestibuli and the scala tympani, the latter being that on the basal side of the spiral lamina. The scala vestibuli opens into the anterior part of the vestibule while the scala tympani begins at the foramen cochleæ (rotundum) where, in the recent state, it is separated from the tympanic cavity by the secondary tympanic membrane. At the apex of the cochlea the two passages communicate with one another through an aperture named the helicotrema.

The **membranous labyrinth** will not be seen during the dissection; it will require to be studied on enlarged models and from diagrams.

## PREVERTEBRAL REGION

The trachea and the œsophagus are to be cut across at the root of the neck, and at the same level the common carotid arteries, the internal jugular veins, the vagus nerves, and the sympathetic cords are to be divided. These structures are then to be pulled away from the front of the vertebral column, and the cut margin of the skull being placed on the table, the separation is to be continued right up to the base of the skull. It is easily effected, for the pharynx is only loosely bound to the front of the vertebral column. On the base of the skull great care must be taken to define the attachments of the **prevertebral muscles** behind and the **pharyngeal muscles** in front, and the point of a knife is then to be carried between them to divide the thick periosteum on the under surface of the occipital bone. The edge of a chisel, not too broad, is to be inserted into this incision, and inclining it slightly backwards it is to be driven through the occipital bone with a mallet. The skull is now to be turned upwards and is to be sawn through on each side from just behind the mastoid process medially and slightly forwards to just behind the jugular foramen. The chisel must then be used again to divide the base of the skull in the interval between the petrous part of the temporal bone and the basilar portion of the occipital bone, that is, from the medial side of the jugular foramen forwards to the end of the transverse incision made with the chisel from below. When this has been done the anterior part of the skull carrying the pharynx and the great blood vessels and nerves can be separated from the posterior part of the skull and the vertebral column. It should be wrapped in a moistened cloth and laid aside until the **prevertebral muscles** and the **articulations** of the cervical part of the **vertebral column** have been examined.

The **prevertebral muscles** of the neck lie in front of the bodies and transverse processes of the cervical and upper two or three thoracic vertebræ, and on them are placed the pharynx and the great vessels of the neck and the sympathetic cords. They are supplied by branches from the roots of the cervical and brachial plexuses. The prevertebral muscles are three in number on each side (Fig. 54); (1) the **longus colli**, the largest and most powerful and lying nearest the middle line; (2) the **longus capitis** which lies lateral to the upper part of the longus colli and extends from some of the cervical transverse processes to the under surface of the skull; and (3) the **rectus capitis anterior**, which lies deep to the

upper part of the longus capitis and extends from the atlas to the occipital bone. These muscles should be cleaned and their attachments defined, and with them there should be examined

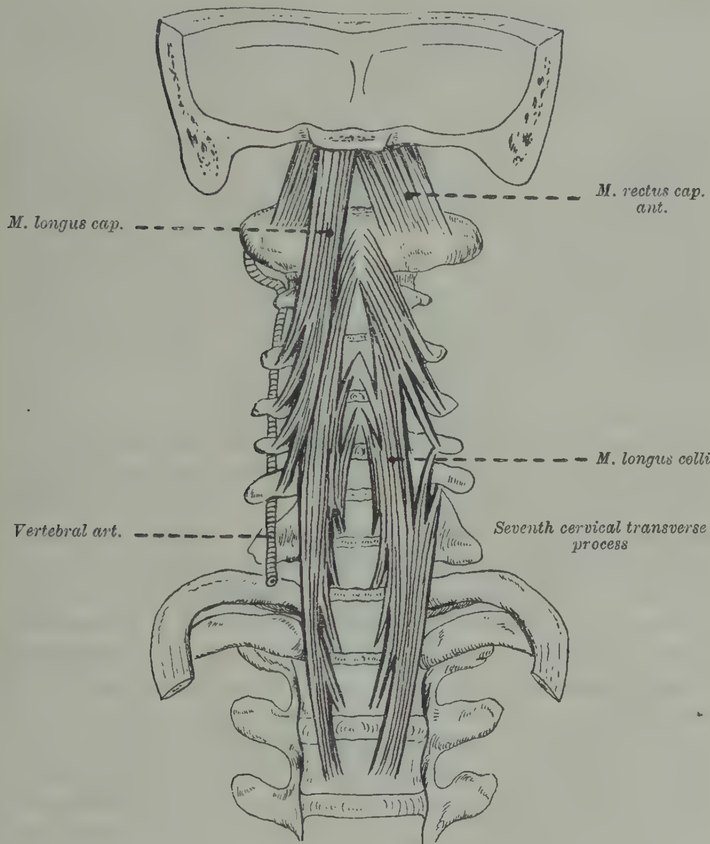


FIG. 54.

*Diagram of the prevertebral muscles of the neck.*

again the **rectus capitis lateralis**, which will have been destroyed in part (p. 119), and the **cervical intertransverse muscles** (p. 41).

The **longus colli** muscle (Fig. 54) consists of three sets of fibres, namely, an intermediate vertical set and upper and lower oblique sets. The vertical part arises from the sides of the bodies of the lower two cervical and the upper two or three thoracic vertebræ and along its lateral border receives slips from the transverse processes of the lower

three cervical vertebræ. It extends vertically upwards and is attached to the bodies of the second, third, and fourth cervical vertebræ. The lower oblique part of the muscle takes origin in common with the vertical part from the bodies of the upper thoracic vertebræ, and is inserted by narrow tendinous slips into the anterior tubercles of the transverse processes of the fifth and sixth cervical vertebræ. The upper oblique part arises by separate tendinous slips from the anterior tubercles of the transverse processes of the third, fourth, and fifth cervical vertebræ. It ascends lateral to the upper end of the vertical part and, inclining medially, is inserted into the tubercle on the anterior arch of the atlas.

The **longus capitis** (Fig. 54) arises by tendinous slips from the anterior tubercles of the transverse processes of the third, fourth, fifth, and sixth cervical vertebræ. It inclines medially as it ascends and is inserted into the basilar process of the occipital bone a little in front of the foramen magnum.

The **rectus capitis anterior** (Fig. 54) is partly covered by the upper part of the longus capitis, which must be turned down from its insertion to bring it into view. It is a short, thick muscle which arises from the front of the lateral mass of the atlas and is inserted into the under surface of the occipital bone behind the longus capitis.

The prevertebral muscles and the scalene muscles must be cut away to expose the cervical **intertransverse muscles**. There are seven pairs of these muscles on each side, an anterior and a posterior muscle passing between the bifid extremities of adjacent transverse processes; the uppermost muscles connect the atlas and the axis and the lowest pass between the seventh cervical vertebra and the first thoracic vertebra. The anterior divisions of the lower six **cervical nerves** pass laterally between the two muscles in each space, but their posterior divisions turn backwards medial to the posterior muscles. The upper two cervical nerves differ from the others; they emerge over the posterior arch of the atlas and the vertebral arch of the axis, respectively.

The **vertebral artery** is to be exposed in its course through the transverse processes, by removing the intertransverse muscles and the rectus lateralis and the superior and inferior oblique muscles which are attached to the atlas. The foramina in the transverse processes are then to be opened with the bone forceps.

The **vertebral artery** was previously exposed in the root of the neck (p. 78), where, as a branch of the first part of the subclavian artery, it was followed as far as the transverse process of the sixth cervical vertebra, into the foramen of which it disappears. It was exposed again in the suboccipital triangle (p. 43) and was also seen in the dissection of the base of the skull, where after entering through the foramen magnum it was cut as it proceeds to its terminal distribution on the brain (p. 130). The part now exposed

passes vertically upwards through the series of foramina in the transverse processes of the upper sixth cervical vertebra, though in passing from the axis to the atlas it runs laterally rather than vertically to gain the more laterally placed foramen of the first vertebra (Fig. 54). Between the transverse processes it lies medial to the intertransverse muscles and passes in front of the anterior divisions of the cervical spinal nerves. It is surrounded in this part of its course by the **vertebral venous plexus**, which terminates below in the **vertebral vein**, and is accompanied by a **plexus of sympathetic nerves.** Small spinal arteries have already been described to arise from it (p. 47), and these and small muscular twigs are its only branches.

FIG. 55.

*The joints between the bodies of the vertebræ.* The intervertebral disc is shown and the two small lateral diarthrodial joints.

The vertebral column must now be sawn across at the level of the seventh cervical vertebra. All the muscle fibres are to be cleaned away from the detached part, for the **vertebral** and the **atlanto-occipital joints** are to be examined.

The articulations between the lower five cervical vertebræ are to be examined first. They are all of similar nature and very much the same in plan as those between the vertebræ of other regions of the column; but the atlas, the axis, and the occipital bone are articulated together in a different way.

The **lower cervical** vertebræ, like the vertebræ below them, are articulated together (1) by their bodies, and (2) by the articular processes of their vertebral arches.

1. The **bodies** of the vertebræ are joined by the **intervertebral fibro-cartilages**, the opposed bony surfaces being coated with a thin layer of hyaline cartilage (Fig. 55). These joints are, therefore, synchondroses; and the individual vertebræ can move only slightly on one another. At the sides of the bodies, however,

where the fibro-cartilages are absent, there are small diarthrodial joints, that is, the bony surfaces are separated from one another and are coated with cartilage, and the cavity is surrounded by a synovial membrane (Fig. 55). The **ligaments** which bind the bodies of the vertebræ together are the common anterior and posterior longitudinal vertebral ligaments, placed, respectively, on their anterior and posterior surfaces. Little dissection is required to establish their connections.

The **anterior longitudinal ligament** lies on the anterior face of the bodies of the vertebræ, and extends from the atlas above to the sacrum below. It is a broad and strong band, firmly attached to the margins of the vertebræ and to the intervertebral discs but only loosely adherent to the central parts of the bones. It consists of several layers of fibres, the most superficial of which are the longest.

The **posterior longitudinal ligament** is placed on the posterior surface of the bodies of the vertebræ and forms the anterior wall of the vertebral canal. It also is firmly attached to the margins of the vertebræ and to the intervertebral discs, and is separated from the central parts of the bodies by some loose connective tissue and small veins. It is broader in the cervical region than in the lower parts of the column.

Two or three of the lower cervical vertebræ should be separated from the rest and divided into lateral halves by a vertical saw-cut; in this way the intervertebral fibro-cartilages can be examined. A coronal section through one side will expose the small lateral diarthrodial joints (Fig. 55).

The **intervertebral fibro-cartilages** are interposed between the adjacent surfaces of the bodies of the vertebræ from the axis to the sacrum, and constitute about one-fourth of the length of the column. They differ in thickness, however, in different parts of the column. The individual discs are thicker in front than behind in the cervical and lumbar regions, and thus produce the curvatures of these parts; in the thoracic region they are nearly of uniform thickness. The peripheral part of each disc is tough and fibrous (annulus fibrosus), while the central part is soft and pulpy (nucleus pulposus).

2. The **vertebral arches** articulate by their articular processes, the joints being of the diarthrodial variety. The surfaces of the bones are covered with articular cartilage and a distinct, though thin and loose, fibrous capsule surrounds the joint cavity. The arches are also bound together by the ligamenta flava, and by the interspinous and the supraspinous ligaments, which were examined when the arches were removed (p. 46). There are also weak intertransverse ligaments which pass between the transverse processes.

The **articulations** between the **axis** and the **atlas** and the **atlas and the occipital** bone belong to the diarthrodial variety, and in

connection with them the ligaments of the vertebræ below are continued upwards in highly specialised form. The specimen is to be examined first from the front, and there is to be defined on it the upward continuation of the **anterior longitudinal ligament** and the **anterior atlanto-occipital membrane.**

The **anterior longitudinal ligament** of the lower vertebræ is continued upwards from the body of the axis to the anterior arch of the atlas to

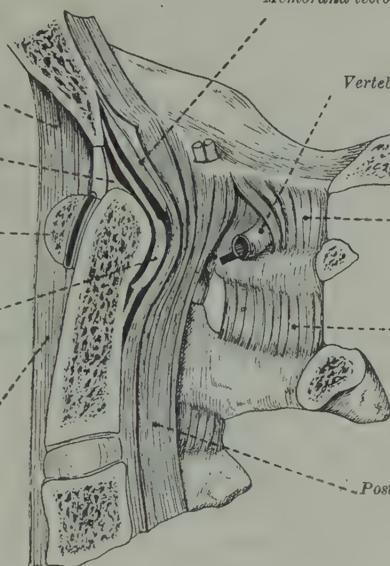


FIG. 56.

*Longitudinal section through the atlanto-axial joint to show the ligaments of the upper end of the vertebral column.*

which it is firmly attached (Fig. 56). It is thick and strong in the middle but thin and membranous at the sides. It is continued above the atlas as the **anterior atlanto-occipital membrane** which extends from the upper margin of the anterior arch of the atlas to the under surface of the occipital bone in front of the foramen magnum (Fig. 56). It also is much thicker in the middle than at the sides.

The specimen is now to be examined from behind. There will be seen on it, and in series with the similar ligaments below, filling the interval between the laminæ of the axis and the posterior arch of the atlas, the uppermost of the **ligamenta flava**; and in the gap between the atlas and the posterior margin of the foramen

magnum, the **posterior atlanto-occipital membrane** (Fig. 56). This is a thin membranous sheet, the lateral border of which arches over the groove behind the articular mass of the atlas in which the vertebral artery is lodged. Not uncommonly this part of the membrane is ossified and converts the groove into a foramen.

The joints between the occipital condyles and the lateral masses of the atlas and between the atlas and the upper articular processes of the axis are surrounded by weak connective tissue capsules (Fig. 57). They should be removed to expose the joint surfaces, and it may then be demonstrated that nodding movements of the head occur at the upper joints and side to side movements at the lower joints.

There is a further articulation, however, between the axis and the atlas, namely that between the odontoid process of the axis and the posterior surface of the anterior arch of the atlas (Fig. 56). It is to be exposed from behind. It is necessary, therefore, to remove with the bone forceps the laminæ of the axis and the posterior arch of the atlas, and then to cut away the squamous part of the occipital bone so that the foramen magnum is freely opened (Fig. 57). This dissection having been completed, the upper part of the spinal cord should be examined and the origin of the spinal part of the accessory nerve from it should be defined. The roots of the first and second cervical nerves are to be cut and the cord removed. A broad membrane will be exposed, stretching upwards from the posterior surface of the body of the axis, where it is continuous with the posterior longitudinal ligament; it extends over the odontoid process and through the foramen magnum to be attached on the upper surface of the basilar process of the occipital bone (Fig. 56). This is the **membrana tectoria**. It is to be cut through and turned upwards and downwards and its attachments defined (Fig. 57). When this is done there will be brought into view the **cruciate** ligament and the **accessory atlanto-axial** ligaments, the former of which especially is to be very carefully studied (Fig. 57).

The **cruciate ligament** consists of a transverse and a vertical part. The **transverse** part is a thick and strong band which is attached on each side to a small tubercle on the medial face of the lateral mass of the atlas, and stretching across the ring of the atlas holds the odontoid process in contact with its anterior arch. Between it and the process there is a synovial cavity. The **vertical** part of the ligament, somewhat variable in its thickness, extends upwards and downwards from the middle of the transverse part (Fig. 57). The upper limb is attached above to the

basilar part of the occipital bone just within the foramen magnum, while the lower limb, much shorter, is fixed to the posterior surface of the body of the axis.

The **accessory atlanto-axial ligaments** (Fig. 57) take origin from the atlas just behind the transverse ligament and run obliquely downwards

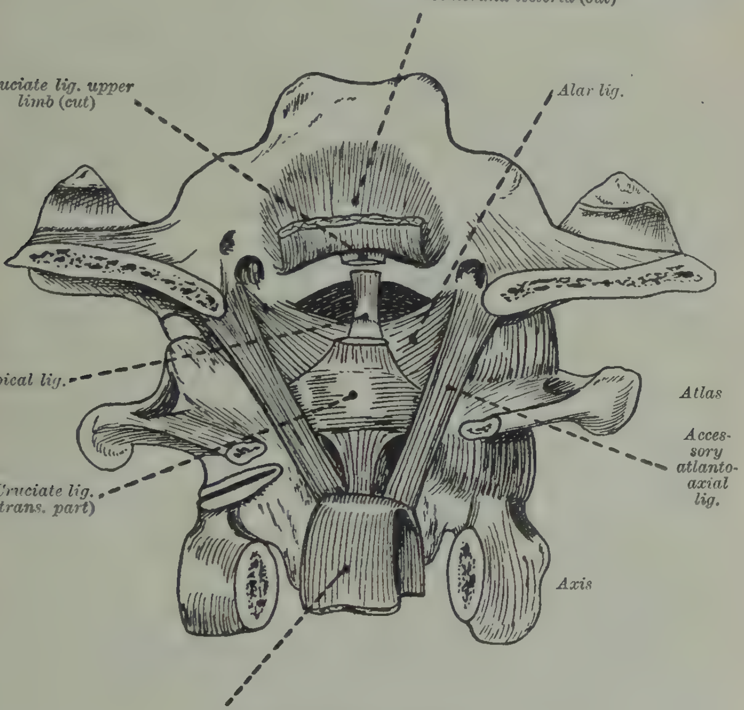


FIG. 57.

*Dissection of the atlanto-axial joints from behind.* The apex of the odontoid process is at the lower end of the apical ligament. The accessory atlanto-axial ligaments are (irregularly) continued to the occipital bone.

to be attached to the back of the body of the axis close to the base of the odontoid process.

The upper limb of the cruciate ligament is to be cut away to bring the odontoid process into view (Fig. 57). From the apex of the process the **apical ligament** will be seen passing up to the anterior edge of the foramen magnum; it is of considerable interest since it is formed round the notochord and its sheath.

The **alar** (or check) **ligaments** will also be exposed (Fig. 57). They are strong bands passing laterally and a little upwards from each side of the summit of the odontoid process to the medial sides of the occipital condyles. They can carry the whole weight of a child's body, as when it is lifted by the head.

## THE MOUTH AND PHARYNX

The dissectors must now turn to the specimen which was laid aside while the prevertebral region was being dissected; on it there are to be studied the **mouth** and the **pharynx** and the **nose** and the **larynx**, the upper ends, respectively, of the digestive and respiratory tracts.

The **mouth** should be examined first; and the student should confirm the findings in the subject by an examination of his own mouth with a looking-glass. The cavity of the mouth consists of two parts; namely, that part between the lips and the cheeks externally and the gums and the teeth internally which is named the **vestibule**, and that part, the **mouth proper**, which is within the teeth. The vestibule is a narrow cleft, unless the cheeks are inflated or the muscles of the face are paralysed, and so long as the teeth are closed only communicates with the mouth behind the last molar teeth. The parotid duct opens into it, on a little papilla opposite the second upper molar tooth: it can often be felt with the tip of the tongue.

The structure of the **lips** has already been fully examined (p. 15), and the student is only reminded that the layers which enter into their formation are, the skin and the mucous membrane, which cover, respectively, the outer and inner surfaces and become continuous with one another on the margin; the muscles which constitute the chief bulk of the lips, and the small labial glands which lie between the muscles and the mucous membrane. The **cheeks** have also been dissected, but the **buccinator** muscle (Fig. 60) remains in position. It is covered on its surface by the remains of the **bucco-pharyngeal fascia** which is attached above and below to the alveolar margins of the maxilla and the mandible and is continued backwards over the wall of the pharynx. The **parotid duct** (Fig. 60) can still be secured; it pierces the fascia and the muscle and the mucous membrane of the cheek, and its small opening opposite the upper second molar tooth should now be found by everting the cheek.

The **gums** (gingivæ) are covered by a smooth, vascular mucous

membrane, which is continuous on one side with the mucous membrane of the lips and cheeks and on the other with the mucous membrane of the mouth. It is firmly connected to the underlying bones by a layer of dense fibrous tissue, and the student should reflect part of a gum to expose this layer and to appreciate its thickness. He should also note that the gum closely embraces the "necks" of the teeth.

The **teeth** should be studied on the permanent specimens in the bone-room.

The **mouth proper** is bounded in front and at the sides by the

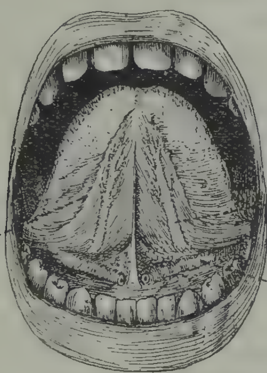


FIG. 58.

*The floor of the mouth and the under surface of the tongue.* The frenulum is shown in the middle line and the openings of the submaxillary ducts are seen at the anterior ends of the plicæ sublinguales.

teeth and the gums; its floor is formed by the **tongue** and the reflections of the mucous membrane from the tongue to the lower gums; the roof is formed by the hard and soft **palate**; while posteriorly it opens into the pharynx through the **isthmus** of the **fauces**.

The **floor** of the **mouth** and the **tongue** are to be examined, the mucous membrane, especially of the tongue, being carefully cleaned with a wet sponge. At the back part of the mouth the mucous membrane is reflected from the side of the tongue to the gum, but in the anterior part the tongue is free and the mucous membrane stretches across the floor from one side to the other. The under surface of the tongue, however, is connected to the floor by a median fold of mucous membrane, the **frenulum**, at the sides of

which, on small papillæ, are the openings of the submaxillary ducts. Between the side of the tongue and the gum, in this region, there can be distinguished the projection formed by the subjacent sublingual gland. It is named the **plica sublingualis** (Fig. 58), and on its summit are the openings of the sublingual ducts.

The **tongue** has already been described to be essentially a muscular organ, and the mucous membrane which covers it to contain large numbers of "taste buds," the peripheral organs of taste. Its movements are concerned with the acts of mastication, deglutition, and articulation; when at rest and the mouth closed, it is moulded into the vaulted arch of the palate. By its extrinsic muscles, which can effect changes in its position as well as in its form, it is attached to the hyoid bone, the styloid processes, the mental tubercles of the lower jaw, and the soft palate and the pharynx; while by the reflections of its mucous membrane it is bound to the floor of the mouth and to the epiglottis.

The tongue is developed in two parts, an anterior **oral** part, forming about two-thirds of the organ, and a posterior **pharyngeal** part; and the mucous membrane which covers these two parts is quite different in its structure and its nerve supply is derived from different nerves. The two parts are marked off from each other on the dorsum of the tongue by a V-shaped groove. The apex of this groove is directed backwards and at it there is a small blind pit, the foramen cæcum, which is the remains of the upper part of the thyreo-glossal duct (p. 62); while the two limbs of the groove, passing forwards, reach the margins of the tongue at the attachments of the palato-glossal folds. The mucous membrane which covers the pharyngeal part of the tongue is smooth and glossy in appearance, though its surface is studded with low flat elevations which are produced by underlying masses of lymphoid tissue. In the centre of each of the projections a small pit can usually be seen. (If the pharyngeal part of the tongue cannot be seen at present, it can be examined after the pharynx is opened.) The mucous membrane of the anterior two-thirds is rough, since it is covered with papillæ. These are of different kinds. The largest and most distinctive are the **circumvallate papillæ**, eight to twelve in number, which are placed along the anterior margin of the V-shaped groove; there is usually a large median papilla just in front of the foramen cæcum. Each papilla consists of a central eminence surrounded by a deep trench, the outer wall of which is raised above the general level of the surface. The tongue must be depressed and pulled well forwards to bring these papillæ into view.

The **fungiform** papillæ are smaller but more numerous than the circumvallate papillæ. They are scattered irregularly over the tongue but are particularly gathered at the tip and the sides. They are globular in form but greatly constricted at their attached ends, and are easily distinguished, in the living person, by their deep red colour. The **conical** papillæ are closely set over the anterior two-thirds of the tongue. They are minute projections, conical in shape, and are arranged in rows parallel with the lines of the circumvallate papillæ. The **filiform** papillæ are similar in shape to the conical papillæ but are much finer, and their apical filamentous parts are whitish in colour.

The mucous membrane on the under surface of the tongue is smooth and shining, and so thin that in the living person the veins of the tongue can be distinctly seen through it. In the middle line the mucous membrane forms the frenulum, an exaggeration of which is often supposed to render an infant "tongue-tied." On either side of the frenulum there is a slight fold of mucous membrane, the edge of which occasionally presents a row of fringe-like processes; it is named the **plica fimbriata** (Fig. 58). If the mucous membrane be removed from the under surface, there will be exposed, beneath a thin covering of muscle fibres, a group of glands aggregated together to form an oval mass about half an inch long: these are the glands of Blandin and Nühn, and they open by a number of ducts on the under surface of the apex of the tongue.

The extrinsic muscles of the tongue should be identified again and followed into the tongue to demonstrate the manner in which their fibres mingle with those of the intrinsic muscles. The nerves of the tongue, namely, the hypoglossal which supplies its muscles and the lingual and glosso-pharyngeal which are distributed to the mucous membrane of, respectively, its anterior two-thirds and posterior third, should be traced as far as possible towards their terminations. The circumvallate papillæ are supplied from the glosso-pharyngeal nerve, which is a nerve of taste and common sensation.

A series of transverse sections should then be made through the tongue from before backwards. It will be seen from these that the tongue is divided into two lateral halves by a vertical median **septum** of fibrous tissue (Fig. 59). This septum extends the whole length of the tongue from its attachment to the hyoid bone behind to its apex in front, and though it does not quite reach the dorsal mucous membrane it forms a remarkably complete partition between the two sides; and there is little anastomoses through it between the two lingual arteries. These vessels should be recognised on the sections, and then the general arrangement of the fibres of the **intrinsic muscles** should be studied. They

are confined to the tongue, and produce, therefore, alterations in its form but not in its position. All are supplied by the **hypoglossal nerve.**

The fibres of the intrinsic muscles of the tongue form four groups (Fig. 59): (1) The **superior longitudinal** fibres form a thin stratum over the whole dorsum of the tongue immediately underneath the mucous membrane. (2) The **inferior longitudinal** fibres form two bundles, one on each side, on the under surface of the tongue, and extend from its root to the tip. Posteriorly each of them lies in the interval between the hyoglossus and genio-glossus muscles. (3) The **transverse** fibres arise from the median fibrous septum and pass laterally to the sides

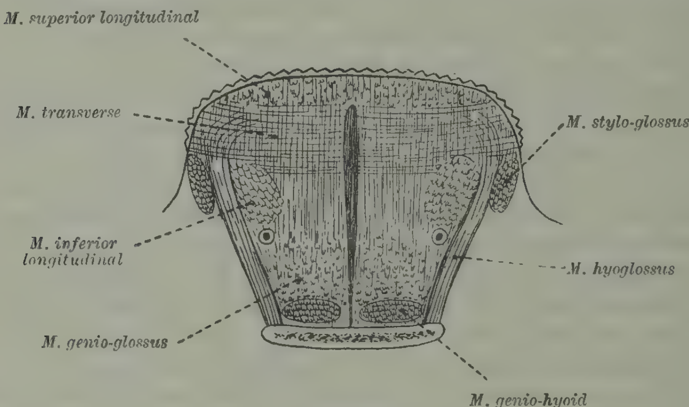


Fig. 59.

*Diagram of a transverse section of the tongue to show the arrangement of the intrinsic muscle fibres.* The thickness of the median fibrous septum has been exaggerated.

of the tongue. (4) The **vertical** fibres extend from the dorsum to the under surface of the fore part of the tongue.

The **roof** of the **mouth** is formed by the palate which consists of two parts, the **hard palate** in front and the **soft palate** behind. Hanging from the middle of the soft palate behind, and resting on the dorsum of the tongue, there is a small conical process, the **uvula.** Along the middle line of the hard palate, which will probably require to be cleaned, there is a linear raphe which ends anteriorly in a small papilla, named the **incisive papilla,** since it is opposite the incisive canal of the maxillary bone. Over the front part of the palate the mucous membrane is thrown into four or five transverse folds or rugæ, but behind this it is smooth and of a paler colour. The rugæ may not be seen on the subject,

but the student can feel them on himself with the tip of his tongue. The structure of the palate will be studied later.

The **isthmus** of the **fauces** is the name given to the aperture by which the mouth communicates with the pharynx, and here again the examination can be made best on the living subject. The isthmus is bounded above by the soft palate, below by the dorsum of the tongue, and on each side by two curved folds of mucous membrane, named, respectively, the **anterior** and **posterior pillars** of the **fauces**. In the interval between the pillars lies the **tonsil**. Strictly speaking, however, the isthmus of the fauces is bounded by the anterior pillars, and the tonsil and the posterior pillars belong to the lateral wall of the pharynx. The structure of these parts will be studied later.

The examination of the **pharynx** is now to be proceeded with. It is a musculo-membranous tube, conical in form, the base being at the base of the skull and the apex at the lower border of the cricoid cartilage where it becomes continuous with the œsophagus. It is about five inches in length. It is placed behind the nasal cavities, the mouth, and the larynx, with each of which it communicates; so that it conducts the air from the nose to the larynx as well as the food from the mouth to the œsophagus. The Eustachian tubes also open into it at its upper part, and thus it communicates also with the tympanic cavities.

The **general relations** of the pharynx have already been indirectly studied. It rests posteriorly on the upper six cervical vertebræ, the prevertebral muscles, and the prevertebral fascia, to which it is bound by loose connective tissue which does not hinder the movements of its walls. On each side it is related to the great vessels and nerves of the neck and to the styloid process, while above it is attached to the base of the skull. Anteriorly its wall is interrupted by the openings of the nasal cavities, the mouth, and the larynx, to the margins of each of which it is attached.

Under ordinary conditions the lower part of the pharynx is compressed from before backwards, so that as seen in transverse section its anterior wall is closely approximated to its posterior wall; but to enable a satisfactory dissection of the walls to be made it is advisable to distend the pharynx moderately with tow, which should be introduced from above.

The **wall** of the pharynx consists of three layers, namely, an external **muscular** layer; an intermediate **fibrous** layer, the pharyngeal aponeurosis; and the **mucous membrane** which lines its interior.

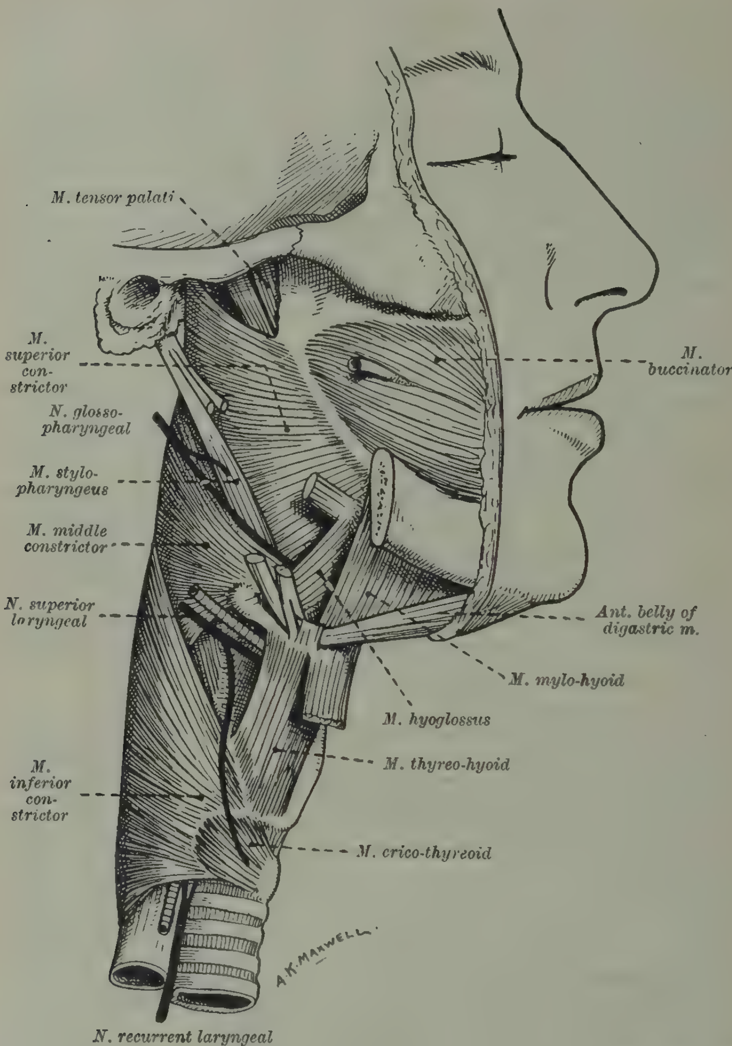


FIG. 60.

*Dissection of the wall of the pharynx and the related parts.* Behind the tensor palati the levator palati muscle can be seen. The parotid duct is shown piercing the buccinator muscle, and between the buccinator and the superior constrictor of the pharynx the pterygo-mandibular raphe is indicated. The superior and inferior laryngeal arteries should be named.

The muscular layer comprises three circularly disposed muscles which are named the **constrictor muscles**, and the **stylo-pharyngeus** and **palato-pharyngeus** muscles on each side which are directed longitudinally. The constrictor muscles are to be cleaned from below upwards by removing the dense covering of fibrous tissue, the **bucco-pharyngeal fascia**, which invests them; and while this is being done numerous small anastomosing veins will be met with. These veins constitute the **pharyngeal venous plexus** which drains the pharynx and the soft palate: it communicates with the pterygoid plexus and with the cavernous sinus (p. 127), and from it two or three channels lead into the internal jugular vein. The **pharyngeal plexus of nerves** will also require to be removed: it is formed, as already described (p. 114), from the glosso-pharyngeal and vagus nerves and the cervical sympathetic cord, and it supplies the muscles and the mucous membrane of the pharynx. The three constrictor muscles can now be seen to be curved sheets, which arise in front from the cartilages of the larynx, the hyoid bone, the mandible and the maxilla, and are inserted behind into a median fibrous raphe; and they are so arranged that they overlap one another from below upwards. The attachments of each of them should now be examined.

The **inferior constrictor** muscle (Fig. 60) arises from the side of the cricoid cartilage and from the inferior cornu and the oblique line on the lamina of the thyreoid cartilage. The fibres spread backwards to be inserted with those of the opposite side into the fibrous raphe in the middle line of the posterior wall of the pharynx. The lower fibres are horizontal but the rest ascend, increasing in obliquity, and the highest fibres terminate only a short distance from the base of the skull. The lower margin of the muscle overlaps the upper end of the œsophagus, and running under it are the inferior laryngeal nerve and the laryngeal branch of the inferior thyreoid artery on their way to the larynx (Fig. 60).

The **middle constrictor** (Fig. 60) is a fan-shaped muscle. It arises under cover of the hyoglossus from the great and small cornua of the hyoid bone and from the lower end of the stylo-hyoid ligament. The fibres diverge from their origin; the lower ones descend beneath the inferior constrictor and the upper ascend and overlap the superior constrictor, and they are inserted into the posterior median raphe. In the anterior part of the interval between the middle and inferior constrictors, the internal laryngeal nerve and the accompanying artery will be seen piercing the thyreo-hyoid membrane to gain the interior of the larynx (Fig. 60).

The **superior constrictor** muscle (Fig. 60) is thinner and paler than the other two. It is a quadrilateral muscle, which arises by a continuous origin, from below upwards, from the side of the tongue, the mucous membrane of the mouth, the posterior end of the mylo-hyoid ridge of the mandible, the pterygo-mandibular raphe which is common to it and the buccinator muscle (Fig. 60), and the hamular process and

the lower third of the posterior border of the medial pterygoid plate. The internal pterygoid muscle will require to be removed to bring the whole of the origin fully into view. The fibres curve backwards to the median raphe but some of the uppermost of them are prolonged upwards to the pharyngeal tubercle on the under surface of the occipital bone. The lower part of the muscle is overlapped by the middle constrictor, and passing into the interval between them is the stylo-pharyngeus muscle.

The **pterygo-mandibular raphe** is a narrow tendinous band which lies between and gives origin to the buccinator and superior constrictor muscles. It extends from the hamular process of the medial pterygoid plate to the posterior end of the mylo-hyoid ridge of the mandible (Fig. 60).

The upper margin of the superior constrictor is a free concave edge, and between it and the base of the skull there is a semilunar interval in which the muscular wall of the pharynx is deficient; this interval is named the **sinus of Morgagni**. The wall of the sinus is formed by the strengthened upper part of the **pharyngeal aponeurosis**, which in this situation is sometimes named the pharyngo-basilar fascia; and in contact with it laterally there are two muscles of the soft palate, the **levator palati** and the **tensor palati** (Fig. 60). The levator muscle lies deep and posterior to the tensor, and in the interval between them close to the base of the skull the cartilaginous part of the **Eustachian** (auditory) **tube** should be felt and then defined.

The **stylo-pharyngeus** muscle is to be followed into the wall of the pharynx by removing the covering middle constrictor; it gradually expands, and while some of its fibres end in the pharynx, others may be followed to the thyreoid cartilage (p. 108). The removal of the muscles will expose the **pharyngeal aponeurosis**, which is much stronger in its upper part, where the muscles are absent, than it is below. It is chiefly through the aponeurosis that the pharynx is attached to the base of the skull.

The pharynx is now to be opened by a median incision through the entire length of its posterior wall. The **mucous membrane** is exposed. It is continuous with the linings of the cavities which open into the pharynx. It is characterised by large numbers of mucous glands and small lymph follicles; in certain situations the lymph follicles are aggregated into large masses, for example, the tonsils.

The soft palate will be seen projecting into the pharynx. It divides the cavity of the pharynx into an upper part, the **naso-pharynx**, which communicates with the nasal cavities; and a lower part, which consists of an **oral** part posterior to the mouth and a **laryngeal** part posterior to the larynx.

The **naso-pharynx**, the widest part of the pharynx, lies immediately behind the nasal cavities and above the soft palate, the upper surface of which forms its floor. The posterior openings of the

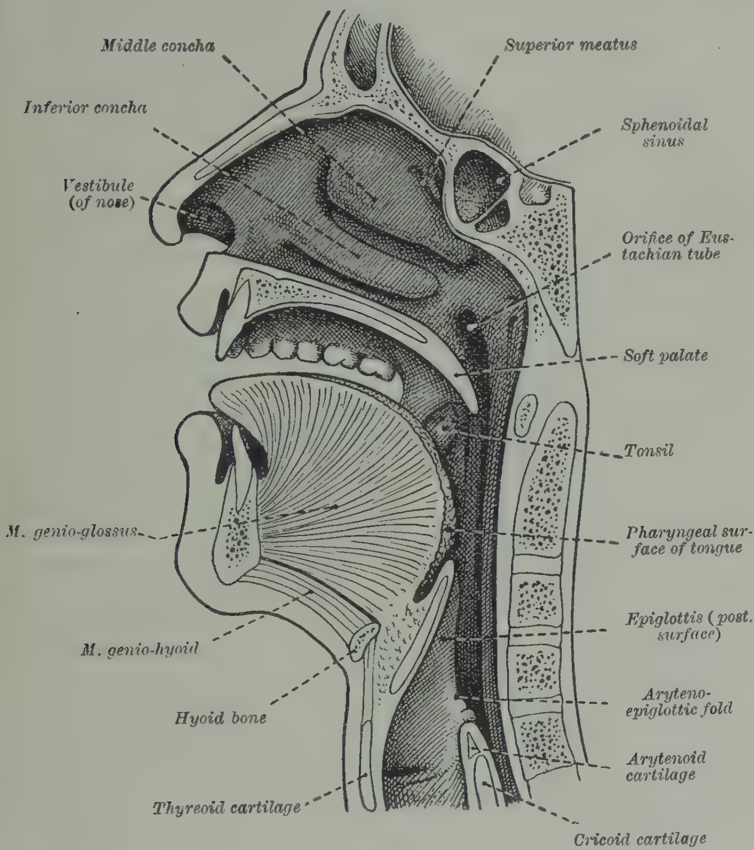


FIG. 61.

*Longitudinal section through the nose, mouth, and pharynx.*

nasal cavities, the **posterior nares** or **choanæ**, are two oblong orifices separated from each other by the posterior edge of the **septum nasi**, which is formed by the vomer; they are bounded above by the base of the skull and below by the hard palate. The roof of the naso-pharynx is formed by the under surface of the basi-occipital and the basi-sphenoid bones covered by a thick periosteum and the

mucous membrane. On the upper part of the posterior wall, and extending on to the roof, there is a prominence, best marked in childhood, produced by a mass of lymphoid tissue; it is known as the **pharyngeal tonsil**, and over it the mucous membrane is wrinkled. In its lower part there is usually to be found the opening of a small median recess, named the "pharyngeal bursa"; it is just large enough to admit a fine probe. It should be noted that the posterior wall and the roof of the naso-pharynx can be palpated by a finger introduced through the mouth. On the lateral wall there is seen on each side, immediately behind the lower part of the corresponding choana, the pharyngeal **orifice** of the **Eustachian** (auditory) **tube**. It is somewhat triangular in shape and is bounded above and behind by a firm rounded prominence, the **torus** or **cushion**, which is caused by the end of the cartilage of the Eustachian tube. A vertical fold of mucous membrane, the **salpingo-pharyngeal fold**, passes downwards from the lower part of the cushion on the wall of the pharynx on which it gradually disappears. Behind the cushion there is a deep recess on the lateral wall of the naso-pharynx; it is named the **pharyngeal recess** or fossa of Rosenmüller.

The **oral** part of the pharynx lies behind the isthmus of the fauces and the pharyngeal surface of the tongue, which looks more or less directly backwards into it, and can now be closely examined. On the lateral walls there are the **posterior pillars** of the **fauces**, which are gradually lost as they are followed downwards. Within these folds are the **palato-pharyngeus** muscles, by the contraction of which the folds are brought nearly into contact, and, the uvula filling the interval between them, the opening into the naso-pharynx is obliterated; the passage of food and fluid from the oral pharynx into the naso-pharynx is thus prevented. In front of the posterior pillar, in a triangular interval bounded in front by the **anterior pillar** of the **fauces**, lies the **tonsil**. The dissection of these parts will be undertaken later.

The **laryngeal** part of the pharynx diminishes rapidly in size, and opposite the lower border of the cricoid cartilage, at the level of the sixth cervical vertebra, it becomes continuous with the œsophagus. In its anterior wall there may be seen, from above downwards, the **epiglottis**, a leaf-like cartilage; the **entrance** of the **larynx**, the sides of which are formed by two sharp folds named the **aryteno-epiglottic folds**, since they stretch from the epiglottis in front to the **arytenoid cartilages** behind, and the posterior surface of the **cricoid cartilage** covered by mucous membrane. The arytenoid cartilages, quite obscured at present by the mucous

membrane which covers them, rest on the upper margin of the cricoid cartilage. On either side of the lower part of the laryngeal opening there is a recess of the pharynx, named the **recessus pyriformis.** Its lateral wall is formed by the lamina of the thyreoid cartilage and the thyreo-hyoid membrane, while medially it is bounded by the aryteno-epiglottic fold ; foreign bodies introduced into the pharynx are liable to be caught in it.

The dissection of the **soft palate** must now be undertaken. It

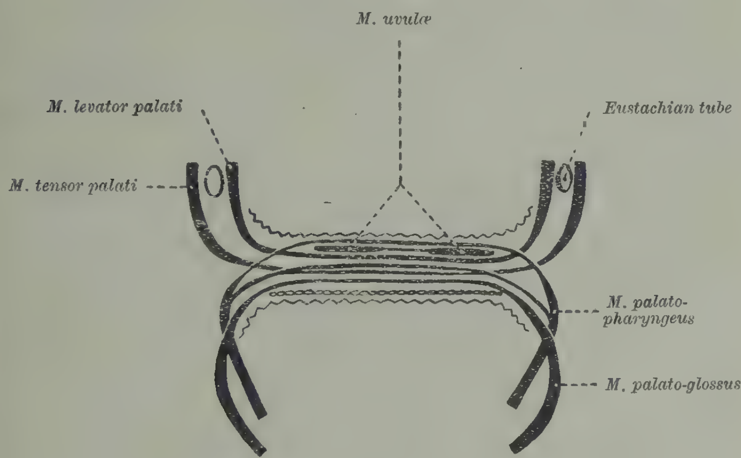


FIG. 62.

*A diagram of the arrangement of the muscles of the soft palate.* The mucous membrane is represented as waved lines, and immediately above that covering the lower surface a layer of palatal glands is represented.

is a movable curtain, being raised during deglutition to assist in shutting off the naso-pharynx from the parts below. It is attached in front to the posterior margin of the hard palate, at the sides it blends with the walls of the pharynx, and its curved posterior border is continued on each side into the palato-pharyngeal fold. The soft palate consists of a fold of mucous membrane between the two layers of which there are the muscles which act on it, an aponeurotic layer, and a considerable amount of glandular and lymphoid tissue.

The dissector is chiefly concerned with the exposure of the muscles. The definition of the individual muscles, however, is difficult, and it is unlikely that their arrangement in definite

layers, as shown in Fig. 62, will be demonstrated. The mucous membrane, which is thin, must first be removed from both surfaces of the palate, when immediately deep to that on its under surface a thick layer of mucous glands will be exposed. The anterior and posterior pillars of the fauces must then be stripped of their mucous membrane, by which proceeding the **palato-glossus** and **palato-pharyngeus muscles** will be exposed. As far as possible these muscles should be followed to their attachments.

The **palato-glossus** is a small slip of muscle, forming with the mucous membrane covering its surface the anterior pillar of the fauces or the palato-glossal fold. It arises in the under surface of the soft palate where it is spread out immediately above the layer of the glands, and is continuous with the muscle of the opposite side. It passes downwards, forwards, and laterally, in front of the tonsil, and is inserted into the side of the back part of the tongue.

The **palato-pharyngeus** muscle arises in the soft palate, in which it is divided into two layers which enclose between them the levator palati and the uvular muscle (Fig. 62). The upper layer is thin and is confined to the posterior part of the palate ; it lies immediately under the mucous membrane and joins the opposite muscle in the middle line. The lower layer, much thicker, lies between the levator and the tensor palati layers, and is continuous with the opposite muscle across the middle line ; it is attached to the palatal aponeurosis and the posterior margin of the hard palate. At the lateral edge of the palate the two layers come together, and the muscle thus formed passes downwards behind the tonsil in the posterior pillar of the fauces, or palato-pharyngeal fold, into the wall of the pharynx. There it spreads out into a thin sheet of fibres which blends with the expansion of the stylo-pharyngeus, and with it ends partly in the pharyngeal wall and partly on the posterior border of the thyreoid cartilage. The upper part of the muscle is joined by a delicate muscular slip from the lower border of the cartilage of the Eustachian tube near its orifice ; this slip is named the **salpingo-pharyngeus** muscle.

The **musculus uvulæ** consists of two delicate slips, one on either side of the middle line, which arise from the posterior nasal spine of the hard palate and descend into the uvula ; as they pass backwards they unite together into one. The muscle lies under the upper layer of the palato-pharyngeus, and is easily defined if this layer be removed.

The **levator palati** and the **tensor palati** muscles have already been identified in relation with the sinus of Morgagni (p. 178), and their superficial relations were studied in the pterygoid region (p. 104). The wall of the pharynx must be removed as much as is necessary to follow these muscles from the base of the skull into the soft palate and in the interval between them the Eustachian tube should be defined.

The **levator palati** is a thick, rounded muscle which arises from the under surface of the apex of the petrous portion of the temporal bone and from the medial border of the cartilage of the Eustachian tube. It passes downwards and forwards across the upper border of the superior

constrictor of the pharynx, and then below the orifice of the Eustachian tube and enters the soft palate. There its fibres spread out between the uvular muscle above, and the deep layer of the palato-pharyngeus muscle below (Fig. 62); most of them blend with the fibres of the opposite side, but some of the anterior fibres are inserted into the palatal aponeurosis.

The **tensor palati** is a flat, band-like muscle closely applied to the deep surface of the internal pterygoid muscle, and placed lateral to and in front of the levator palati (Fig. 60). It arises from the scaphoid fossa at the base of the medial pterygoid plate, from the posterior border of the under surface of the great wing of the sphenoid bone and from its spinous process, and from the lateral wall of the cartilage of the Eustachian tube. The muscle descends along the lateral surface of the medial pterygoid plate, and ends in a rounded tendon which winds round the hamulus and passes horizontally into the soft palate. Between the tendon and the hamulus there is a small bursa. In the palate the tendon spreads out above the palato-glossus fibres (Fig. 62), and is inserted into the palatal aponeurosis and into the horizontal part of the palate bone.

The **palatal aponeurosis** is a thin, firm, fibrous layer attached to the posterior margin of the hard palate. It supports the muscles and gives strength to the anterior part of the soft palate, but as it is followed backwards it becomes very thin and hard to define. Laterally it is continuous with the pharyngeal aponeurosis. The tensor palati is in great part attached to it.

The chief **artery** of the palate is the **ascending palatine** branch of the facial artery; it is usually easily found on the lateral surface of the lower part of the levator palati muscle which it accompanies into the palate. The other vessels, the **palatine** branch of the ascending pharyngeal artery and the **descending palatine** branch of the internal maxillary artery, are as a rule smaller and more difficult to dissect, though the latter may be seen under the mucous membrane of the lower surface. The **nerves** of the soft palate are not to be looked for. Two branches enter it from the spheno-palatine (Meckel's) ganglion and are probably distributed to the mucous membrane. The tensor palati muscle is supplied by a branch from the otic ganglion which rests on its surface (p. 104), the fibres probably being derived from the mandibular nerve; the other muscles are probably supplied by the accessory nerve through the pharyngeal branch of the vagus nerve.

The **tonsils** are two prominent masses, one on either side, situated immediately above the pharyngeal part of the tongue and in the triangular interval between the anterior and posterior pillars of the fauces. The tonsil consists of an aggregation of lymphoid tissue under the mucous membrane. It does not, however, completely fill the interval between the pillars, so that there is a small depression, the **supratonsillar recess**, above it. The lower part of the tonsil is sometimes, especially in the child, covered by a fold of mucous membrane, the **plica triangularis**, the space

between the plica and the surface of the tonsil being known as the **tonsillar sinus**; in many instances, however, the sinus is obliterated by its walls becoming adherent, and the lower part of the tonsil is then said to be "embedded." The surface of the tonsil presents a number of orifices which lead into recesses or crypts in its substance. The deep surface of the tonsil is adherent to a fibrous capsule and is separated from the superior constrictor muscle by some loose connective tissue, which allows the tonsil to be pulled forwards away from the pharyngeal wall. The facial artery lies on the surface of the superior constrictor opposite the tonsil and sends twigs into it; other vessels are derived from


FIG. 63.

*A section through the Eustachian tube to show the cartilage in its wall (enlarged).* The cavity of the tube is in solid black.

the palatine branches of the internal maxillary and ascending pharyngeal arteries.

The cartilaginous part of the **Eustachian tube** should now be examined, the position and direction of the canal being defined by passing a probe into it through its pharyngeal opening. It is lodged on the base of the skull in the groove between the petrous part of the temporal bone medially and the great wing of the sphenoid laterally, and is directed, from the pharynx, postero-laterally with a slight inclination upwards. It passes first above and then on the lateral side of the levator palati muscle and in the rest of its extent it lies between this muscle and the tensor palati. The removal of the mucous membrane which covers the end of the tube will show that in its wall there is a plate of cartilage which is folded on itself and forms the upper and medial

walls; below and laterally the cartilage is deficient and the wall is formed by dense fibrous tissue (Fig. 63). The projecting end of the cartilage causes the elevation of the torus already described on the lateral wall of the naso-pharynx. The interior of the tube is lined with mucous membrane continuous with that of the pharynx and of the tympanic cavity.

There is a small muscular slip, the **dilator tubæ**, attached to the lateral margin of the cartilage of the Eustachian tube (Fig. 63); it descends on the lateral side of the tube and joins the tensor palati muscle.

The **intra-petrous** part of the **internal carotid artery** should be examined at the present time on account of its relation to the Eustachian tube. The artery traverses the bone in the carotid canal and is accompanied by the internal carotid **sympathetic plexus** and a number of small veins. The carotid canal is to be opened from below with the bone forceps. The part of the artery contained in it is about three-quarters of an inch long. At first it ascends vertically and then bending suddenly it runs horizontally and medially and emerges from the canal at the apex of the petrous bone. It then crosses the foramen lacerum and piercing the external layer of the dura mater enters the cavernous sinus, where it was previously examined. In the carotid canal it lies in front of the tympanic cavity and the cochlea, from the former of which it is separated only by a thin plate of bone (Fig. 52); and it is postero-medial to the Eustachian tube and below the semilunar ganglion. The internal carotid **nerve plexus**, which accompanies the artery, is the continuation of the internal carotid nerve which proceeds from the upper end of the superior cervical sympathetic ganglion (p. 115). It is continued along the artery through the cavernous sinus and on to its terminal cerebral branches, but its dissection is hardly to be attempted by the student.

## THE LARYNX

The larynx is the upper expanded part of the respiratory tract and is specially modified for the production of the voice. It lies below the hyoid bone and the tongue and is directly continued into the trachea below. Posteriorly it is related to the pharynx, while anteriorly it is covered by the skin, the fasciæ and the infra-hyoid muscles; on each side the lateral lobe of the thyreoid gland rests on it and it is related to the great vessels of the neck. Its position alters with movements of the head and during deglutition,

but it may be regarded to lie opposite the fourth, fifth, and sixth cervical vertebræ in the male and a little higher in the female and in childhood.

The walls of the larynx are formed by the **laryngeal cartilages**, which are articulated with one another and are connected together by ligaments. They are moved on one another by the **laryngeal muscles**, the movements being such as to alter the position and tension of the **vocal cords**, two ligamentous folds which cross the interior of the larynx. The cavity of the larynx is lined with mucous membrane.

The larynx is to be placed on a block with the anterior surface upwards and fixed in that position with pins. The **external laryngeal nerve** is to be traced to the **crico-thyreoid muscle** and the **internal** and **recurrent** (inferior) **laryngeal nerves** and their accompanying vessels, the **superior** and **inferior laryngeal arteries**, are to be secured (Fig. 60). The dissector should then remove the thyreoid gland, and clear away entirely the omo-hyoid, sterno-hyoid, sterno-thyreoid, and thyreo-hyoid muscles. The fibres of origin of the inferior constrictor muscle of the pharynx are also to be removed from the **thyreoid** and **cricoid cartilages**. The **thyreo-hyoid membrane**, the **crico-thyreoid muscles**, and part of the **crico-thyreoid membrane** are now exposed; their attachments are to be defined and they are to be examined (Fig. 64).

The **thyreo-hyoid membrane** (Fig. 64) is a broad sheet which fills the interval between the thyreoid cartilage and the hyoid bone. It consists of a thick central part and rounded cord-like marginal parts, which are largely composed of elastic fibres, but in the intervals between these parts it is thin and membranous. The central part is attached above to the deep surface of the upper margin of the hyoid bone and below it is fixed to the sides of the deep median notch in the upper margin of the thyreoid cartilage. The upper part of its anterior surface, therefore, lies behind the body of the hyoid bone, a bursa being interposed; so that in certain movements of the head and in swallowing the upper border of the thyreoid cartilage is allowed to slip upwards behind the hyoid bone. On each side of the central part the thin membranous part is attached to the upper border of the lamina of the thyreoid cartilage below and to the upper margin of the great cornu of the hyoid bone above. It is pierced by the internal laryngeal nerve and the superior thyreoid artery. The marginal cord-like parts of the membrane extend on each side from the extremity of the superior cornu of the thyreoid cartilage to the tip of the great cornu of the hyoid bone; a small, oval, cartilaginous or calcified nodule, the cartilago triticea, is usually developed in each of them (Fig. 64).

The **crico-thyreoid muscle** (Fig. 60), triangular in form, arises from the front and lateral part of the cricoid cartilage. Its fibres diverge as they pass backwards and upwards, and as a rule can be separated into two groups at their insertion; the lower fibres are inserted into the

inferior cornu of the thyreoid cartilage and the anterior fibres are attached to the lower border of the posterior part of its lamina. The lower fibres are closely associated with the origin of the inferior constrictor muscle of the pharynx.

The crico-thyreoid muscles are to be cut away to expose the **crico-thyreoid membrane.**

The **crico-thyreoid membrane** or conus elasticus (Fig. 64) is divisible into a median and two lateral parts. The median part, broad below and narrow above, extends from the upper border of the anterior arch of the cricoid cartilage to the middle part of the lower border of the thyreoid cartilage. Each lateral part of the ligament is attached below along the inner edge of the upper border of the cricoid cartilage and extends upwards on the medial side of the lamina of the thyreoid cartilage (Fig. 67) so that a seeker may be pushed up between the two structures for a short distance. It ends above in a free thickened border which lies in the substance of the vocal cord and is attached behind to the vocal process of the arytenoid cartilage and in front to the angle of union between the two laminæ of the thyreoid cartilage (Fig. 68). Its deep surface is covered by the mucous membrane of the larynx (Fig. 67).

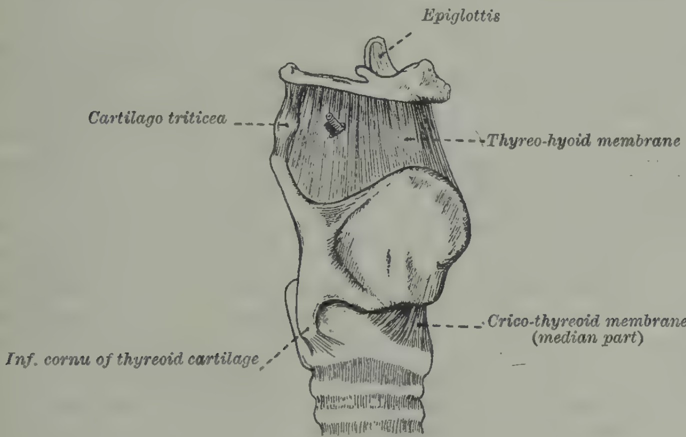


FIG. 64.

*The cartilages and ligaments of the larynx from the side.* The oblique line of the thyreoid cartilage should be named and the attachments of the muscles to it indicated.

The **thyreoid cartilage,** the largest of the laryngeal cartilages, will now be fully exposed from the front and can be examined (Fig. 64). It consists of two flat plates, named the laminæ, which are widely separated behind but are joined together in the middle line in front. The laminæ are fused, however, only in their lower

parts; above they are separated by a deep V-shaped notch, the thyreoid notch. In the adult female the laminæ meet at an angle of about 120°, but in the male they meet at an angle of 90°, and form a projection, most prominent at its upper part, which has been named the pomum Adami. The posterior border of each lamina is thickened and is prolonged upwards and downwards in two slender processes or cornua (Fig. 64). The superior cornu is connected to the tip of the great cornu of the hyoid bone by the lateral part of the thyreo-hyoid membrane, while the inferior cornu, somewhat thicker and shorter, articulates with the side of the cricoid cartilage. The surface of the lamina is relatively flat. It is crossed from above downwards and slightly forwards by an oblique line or ridge, at each end of which there is a distinct prominence, the superior and the inferior tubercle. The ridge gives attachment to the thyreo-hyoid and sterno-thyreoid muscles while the inferior constrictor muscle of the pharynx arises from the smooth area behind it. The inner surface of the lamina is smooth. Below and in front it forms part of the wall of the larynx and attached to it are certain of the laryngeal ligaments, but above and behind, as will be seen again if the specimen be turned (Fig. 65), it is covered by the mucous membrane of the pyriform recess of the pharynx (p. 181).

The larynx must now be fixed in position so that it can be examined from behind, the pharynx and the œsophagus being widely opened and, if necessary, cut away. The parts which bound the entrance to the larynx should be studied first. This aperture is large and obliquely placed, sloping rapidly from above downwards and backwards. Anteriorly it is bounded by the **epiglottis**, a thin leaf-like lamina of yellow fibro-cartilage, which projects upwards behind the base of the tongue (Fig. 65). The epiglottis is broad and rounded above and is free, but below it becomes pointed and is prolonged to the angle between the laminæ of the thyreoid cartilage to which it is bound by the strong and elastic thyreo-epiglottic ligament (Fig. 66). As it passes the hyoid bone it is attached to it by a broad band, the hyo-epiglottic ligament (Fig. 66). The lateral borders of the epiglottis are only partially free, the lower parts being enclosed in the **aryteno-epiglottic folds** of mucous membrane; these folds pass backwards from the epiglottis to the arytenoid cartilages. The anterior or lingual surface of the epiglottis is free only in its upper part, for lower down the mucous membrane is reflected forwards from it towards the base of the tongue. Three vertical folds are formed in the

reflection, a median **glosso-epiglottic fold** and two lateral **pharyngo-epiglottic folds**, the latter of which connect the epiglottis with the lateral walls of the pharynx; in each fold there is a small amount of elastic tissue between the layers of mucous membrane. The two small fossæ between the tongue and the epiglottis which are bounded by these folds are named the **valleculæ**. The posterior surface of the epiglottis is free in the whole of its extent and faces into and forms the anterior wall of the upper part of the larynx. The upper part of this surface is convex owing to the cartilage being moulded on the base of the tongue; below this there is a slight concavity, and still lower a well-marked swelling named the **cushion** or **tubercle** of the epiglottis; it is a conspicuous structure in the clinical examination of the larynx.

The **aryteno-epiglottic folds** are folds of mucous membrane, between the two layers of which there is some connective tissue and the **aryteno-epiglottic muscles** (Fig. 65). Posteriorly, close to its attachment to the arytenoid cartilage, there are two small nodules of cartilage in each fold, of which the anterior is the **cuneiform** and the posterior, which surmounts the arytenoid cartilage, is the **corniculate cartilage**. These nodules give rise to two small rounded eminences in the posterior part of the fold and are easily seen when the larynx is examined clinically in the living subject; they should be felt between the finger and thumb in the specimen, but often it is not easy to distinguish the cuneiform cartilages at all.

The cavity of the larynx is to be looked into from above. It is smaller than would be expected from its exterior. Crossing the cavity antero-posteriorly, two shelf-like folds of mucous membrane will be seen projecting inwards from each side (Fig. 67); the upper folds, rather more widely separated than the lower, are named the **false vocal cords** (plicæ ventriculares) while the lower pair are the **vocal cords** (plicæ vocales). The latter are the chief agents in the production of the voice and, as already stated, they are changed in position and in the degree of their tension by the action of the laryngeal muscles and the elasticity of the laryngeal ligaments.

The mucous membrane which covers the posterior surface of the cricoid and arytenoid cartilages must now be removed, care being taken to preserve the **recurrent laryngeal nerve** and the **inferior laryngeal artery** which pass upwards between the cricoid and thyreoid cartilages. On the posterior aspect of the cricoid cartilage the dissector will readily recognise the **posterior crico-**

**arytenoid** muscles (Fig. 65). The tendinous band through which the longitudinal fibres of the œsophagus are fixed to the cricoid cartilage must also be defined; it is attached to the prominent median ridge on the back of the cartilage. On the posterior surface of the arytenoid cartilages and stretching across the interval between them, **arytenoid muscle** should be defined. It consists of deep transverse fibres and superficial oblique fibres, the

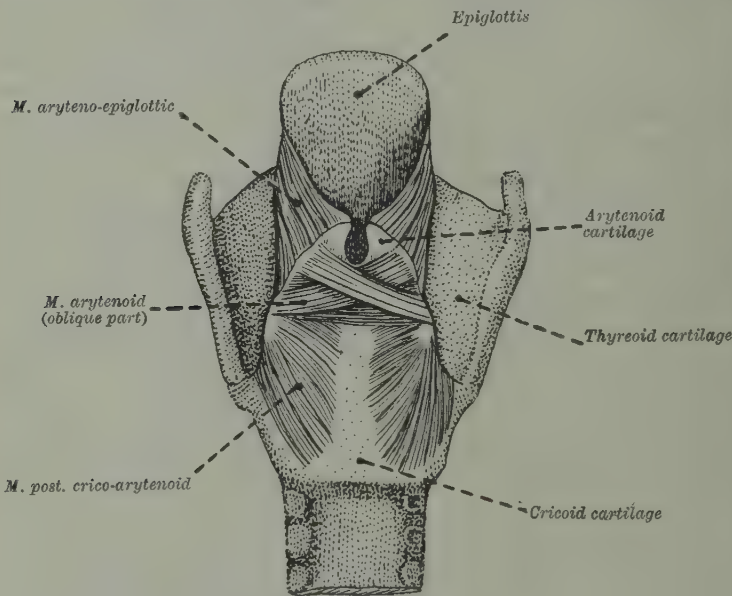


Fig. 65.

*The muscles and cartilages of the larynx from behind.*

latter of which decussate across the middle line and are continued into the aryteno-epiglottic folds (Fig. 65). The lateral layers of mucous membrane are then to be removed from the aryteno-epiglottic folds. If this be done with care, there will be exposed within each fold the **aryteno-epiglottic muscle**, small in size and formed of pale fibres, and the **corniculate** and **cuneiform cartilages.** The muscles which are now exposed should be examined.

The **posterior crico-arytenoid** muscle (Fig. 65) arises from the shallow depression on the lateral part of the broad posterior surface of the cricoid cartilage, the muscles of the two sides being separated by the prominent median ridge. The fibres of the muscle are directed upwards and

laterally and converge to be inserted into the muscular process which projects laterally from the base of the arytenoid cartilage (Fig. 68).

The **arytenoid** muscle (Fig. 65) consists of two parts, transverse and oblique. The **oblique** part is placed superficial to the transverse part. It consists of two bundles of fibres which cross each other like the limbs of the letter X. Each bundle arises from the back of the muscular process of one arytenoid cartilage and passes to the apex of the opposite cartilage into which some of its fibres are inserted; the remainder are continued round the lateral margin of the cartilage and are prolonged in the aryteno-epiglottic fold to the epiglottis as the **aryteno-epiglottic** muscle. The **transverse** fibres of the arytenoid muscle bridge the interval between the arytenoid cartilages, to the lateral borders of which they are attached.

The remaining laryngeal muscles are to be dissected only on one side. On that side the lateral part of the thyreo-hyoid membrane is to be divided and the inferior horn of the thyreoid cartilage disarticulated from the side of the cricoid cartilage. The lamina of the thyreoid cartilage must now be divided a little distance short of the middle line and the detached piece of cartilage must be carefully removed. In old subjects it will be noted that the cartilage is more or less calcified. Two muscles are now exposed, namely, the **lateral crico-arytenoid** below and the **thyreo-arytenoid**, a broad sheet of fibres, above. They must be very carefully cleaned and as far as possible their attachments are to be defined; and while this is being done branches of the **recurrent laryngeal nerve** are to be traced to them. The trunk of the nerve has already been secured (Fig. 60). It is now to be followed upwards on the lateral surface of the cricoid cartilage immediately behind the crico-thyreoid articulation. About the level of the articulation it divides into two branches, the anterior of which supplies the lateral crico-arytenoid and thyreo-arytenoid muscles, while the posterior branch passes through and supplies the posterior crico-arytenoid and then enters the arytenoid muscle. The recurrent nerve, therefore, supplies all the muscles of the larynx with the exception of the crico-thyreoid muscle which is supplied by the external laryngeal nerve.

The **lateral crico-arytenoid** muscle is smaller than the posterior muscle. It is triangular in form. It arises from the upper border of the lateral part of the cricoid cartilage, and passing obliquely upwards and backwards, its fibres converge to be inserted into the front of the muscular process of the arytenoid cartilage.

The **thyreo-arytenoid** is a broad, thin sheet of muscle fibres, which lies lateral to the vocal cord and the ventricle of the larynx and is covered by the lamina of the thyreoid cartilage. It arises in front from the angle of union of the two laminæ of the thyreoid cartilage and from the median part of the crico-thyreoid membrane and passes backwards to be

inserted into the base and the lateral surface of the arytenoid cartilage. Several different parts have been distinguished in the muscle. Thus: (1) From the upper part of the sheet a number of fibres pass into the aryteno-epiglottic fold and are continued to the side of the epiglottis; they are named the **thyreo-epiglottic** muscle. (2) A few fibres extend along the wall of the ventricle of the larynx and are known as the **ventricularis** muscle. (3) The lower and deeper fibres form a band, triangular on transverse section, which is named the **vocalis** muscle (Fig. 67). It runs parallel with the vocal cord and some of its fibres are attached to the ligament of the cord; the remainder are attached to the lateral surface of vocal process of the arytenoid cartilage (Fig. 68).

The **recurrent laryngeal nerve** arises from the vagus nerve, but differently on the two sides of the body (p. 114). It has already been followed upwards in the neck in the groove between the œsophagus and the trachea to the point at which it disappears under the lower border of the inferior constrictor muscle of the pharynx (Fig. 60). It then ascends on the lateral side of the cricoid cartilage, and as already described breaks into two branches which supply all the muscles of the larynx with the exception of the crico-thyreoid muscle. It is, therefore, the motor nerve to the larynx, but it also contains a few sensory fibres which are distributed to the mucous membrane of the larynx below the vocal cords; and it communicates by its posterior branch with the internal laryngeal nerve.

The lateral crico-arytenoid muscle is now to be removed and the dissector should then pick away the fibres of the thyreo-arytenoid muscle in order to display the relation of the vocalis muscle to the vocal ligament. The vocalis may then be removed. The outer surface of the lateral part of the crico-thyreoid membrane (conus elasticus) will now be exposed, and it will be demonstrated to be continued into the vocal cord, of which, by its thickened free border, it forms the vocal ligament (Fig. 67).

The cavity of the larynx is to be opened by dividing the cricoid cartilage in the middle line and the incision should be continued in the middle line of the trachea. If the two halves of the larynx be now separated the interior of the cavity can be fully examined. It is subdivided into three parts; the upper part, the **vestibule**, lies above the false vocal cords, the intermediate part is the interval between the false and the true vocal cords, and the lower part lies below the vocal cords and is continued into the trachea (Fig. 66). The walls of these parts are to be examined on the side on which the muscles are intact.

The **vestibule** diminishes in width from above downwards and, owing to the obliquity of the entrance to the larynx, the anterior wall is longer than the posterior wall (Fig. 66). The anterior wall is formed by the posterior surface of the epiglottis and the thyreo-epiglottic ligament, both being covered with mucous membrane. Each lateral wall is formed by the medial surface of the aryteno-epiglottic fold. For the most part it is smooth and slightly concave, but in its posterior part

there are two vertical elevations, one posterior to the other and separated by a slight groove (Fig. 66). The anterior elevation is formed by the cuneiform cartilage, while the posterior is due to the anterior margin of the arytenoid cartilage and the corniculate cartilage above it. The posterior wall of the vestibule is narrow and corresponds to the interval between the arytenoid cartilages.

The **intermediate part** of the laryngeal cavity, bounded above by the false vocal cords and below by the true cords, is the smallest subdivision of the three (Figs. 66 and 67). Opening into it, on each side, is a recess named the **ventricle** (or saccule) of the larynx, the extent of which should

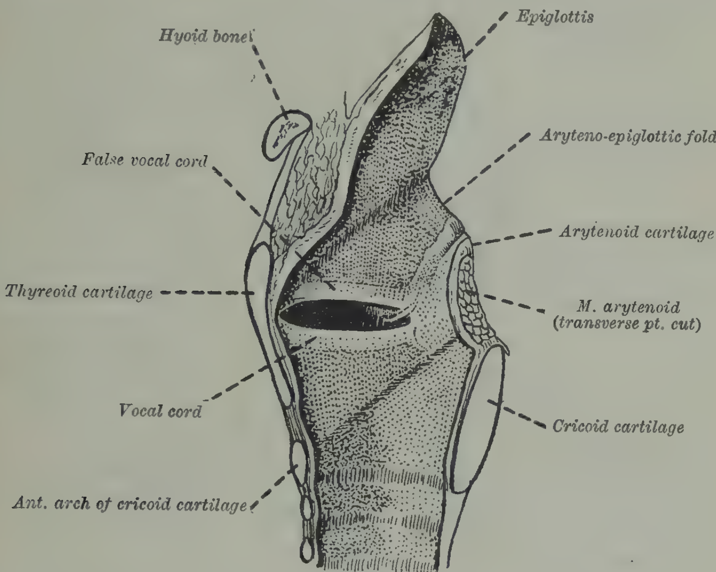


FIG. 66.

*The side wall of the cavity of the larynx.* Note the attachment of the epiglottis to the thyreoid cartilage.

be explored with a seeker. It passes upwards for about half an inch, undermining the false cord, and ends blindly about the level of the upper border of the thyreoid cartilage (Fig. 67). The upper part of the cavity is much narrower than the lower part, into the anterior part of which it opens by a narrow slit-like aperture; it is sometimes named the appendix of the ventricle. Numerous mucous glands open into it, the secretion of which will be poured down on the vocal cord, and will lubricate its surface.

The **lowest part** of the laryngeal cavity leads directly into the trachea (Fig. 66). Above it is narrow from side to side, but it gradually widens out below, until at its lowest part it is circular like the trachea. It is bounded in front and at the sides by the inner surface of the crico-thyreoid membrane (Fig. 67), and behind by the inner surface of the

cricoid cartilage. A seeker should be pushed through the crico-thyreoid membrane from the front. It is to be carefully noted that it enters the larynx below the vocal cords.

The **mucous membrane** of the larynx is continuous with that of the pharynx above and with that of the trachea below. Over the posterior surface of the epiglottis and over the true vocal cords it is thin and tightly bound down to the underlying tissues, the submucous tissue being practically absent; over the other parts,

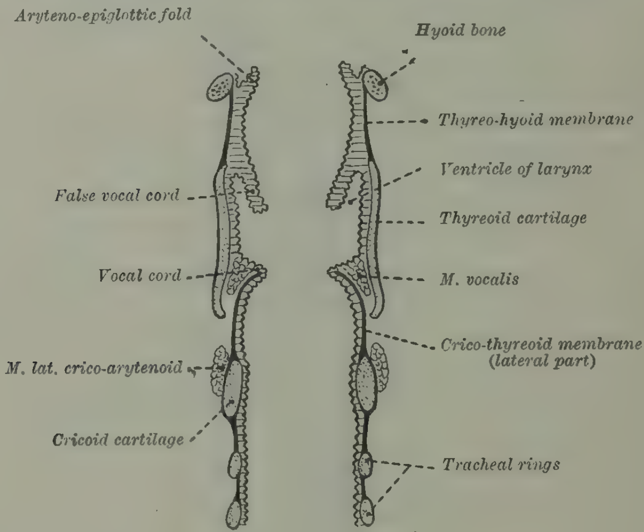


FIG. 67.

*A diagram of the larynx in vertical transverse section.*

however, the submucous tissue is abundant and the mucous membrane can be separated easily from them. Except over the true vocal cords it contains large numbers of mucous glands.

The **false vocal cords** (plicæ ventriculares) are soft and flaccid folds of mucous membrane (Fig. 67), the interval between which is considerably wider than that between the true cords; when the larynx is examined from above, therefore, the four folds can be seen. Each fold contains a few muscle fibres, numerous mucous glands, and a narrow, indefinite band of fibrous tissue, which is named the ventricular ligament.

The true **vocal cords** (plicæ vocales) are the means by which the voice is produced, the false cords being of little importance in this respect. They are almost white in colour, the mucous

membrane covering them being thin and firmly adherent to the subjacent **vocal ligaments.** They extend from the angle between the laminæ of the thyreoid cartilage in front to the vocal processes of the arytenoid cartilages behind (Fig. 68), each fold being sharp and prominent and in transverse section triangular in shape (Fig. 67). The interval between the cords is named the **glottis** or **rima glottidis**, and it is to be noted that it is continued backwards for about a quarter of an inch between the vocal processes of the arytenoid cartilages. The length of the entire opening is

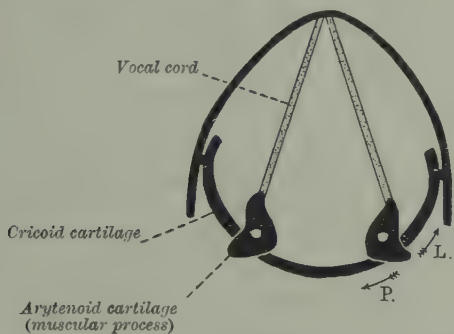


FIG. 68.

*Diagram of the attachments of the vocal cords and of the boundaries of the widely open rima glottidis.* The arytenoid cartilages move round vertical axes, represented by white dots, so that their vocal processes which project forwards may be approximated or separated from one another. P. shows the direction of the pull of the posterior crico-arytenoid muscle on the muscular process; it would, therefore, separate the cord from its fellow. L. shows the pull of the lateral crico-arytenoid muscle which would approximate the one cord to the other.

about an inch in the adult male and about three-quarters of an inch in the female. The form of the opening can be considerably altered by the arytenoid cartilages being turned round their vertical axes and the vocal processes, carrying the vocal cords, being made to approach or separate from another (Fig. 68). The opening can thus be reduced to a mere chink, as in singing a high note, but when opened as widely as possible it becomes a lozenge-shaped space (Fig. 68). In ordinary respiration it is intermediate between these two forms.

The **vocal ligament**, which lies within the vocal cord, has already been described as the upper free border of the lateral part of the crico-thyreoid membrane (Fig. 67). It consists of a band of yellow elastic tissue, and is attached in front to the angle of the thyreoid cartilage

and behind to the vocal process which projects forwards from the base of the arytenoid cartilage (Fig. 68). The vocalis muscle lies lateral to and parallel with it, and it is covered by mucous membrane which is thin and firmly bound to it.

The **internal laryngeal nerve** and the **superior laryngeal artery** are now to be followed through the thin lateral part of the thyreo-hyoid membrane and then along the lateral wall of the sinus pyriformis of the pharynx to the larynx. The nerve should be made taut and fixed, and then the mucous membrane which covers it should be removed; in this way the nerve can be easily discovered and its branches traced to the walls of the larynx of which it is the sensory nerve.

The **internal laryngeal nerve** is the larger division of the superior laryngeal branch of the vagus nerve (p. 114). It is a sensory nerve and its branches are distributed chiefly to the mucous membrane of the larynx. It pierces the lateral part of the thyreo-hyoid membrane, in company with the superior laryngeal artery, and then divides into a number of branches. The uppermost of these are distributed to the aryteno-epiglottic fold, to the epiglottis and the base of the tongue, and the three folds between them. The intermediate branches supply the side wall of the larynx as far down as the true vocal cords, while the lowest branches supply the mucous membrane over the posterior surface of the arytenoid and cricoid cartilages, and one of them, a fairly large twig, joins the posterior branch of the recurrent laryngeal nerve.

The **superior** and **inferior laryngeal arteries** are distributed in company with their companion nerves, and supply the mucous membrane, the glands, and the muscles of the laryngeal wall.

The remaining part of the thyreoid cartilage is now to be removed from the cricoid cartilage by dividing the fibrous capsule which surrounds the **crico-thyreoid joint**. This articulation is of the diarthrodial variety. The movements which take place at these joints are of two kinds, gliding and rotatory. The rotatory movement is one in which the cricoid cartilage rotates round a transverse axis which passes through the two joints, the movement being produced by the **crico-thyreoid** muscles. These muscles pull the upper border of the anterior part of the cricoid cartilage upwards and backwards and thus increase the distance between the angle of the thyreoid cartilage and the vocal processes of the arytenoid cartilages, which surmount and follow the downward and backward movement of the upper border of the posterior part of the cricoid cartilage. The vocal cords are thus made tense by the contraction of the crico-thyreoid muscles. Relaxation of the cords is brought about by the elasticity of their ligaments and probably they may be further relaxed by the contraction of the **vocales** parts of the thyreo-arytenoid muscles.

The **cricoid** and the **arytenoid cartilages** are now to be cleaned by removing the muscle fibres attached to them and the mucous membrane with which they are covered. While this is being done, the two **cuneiform cartilages**, small rod-shaped nodules of yellow elastic cartilage, should be sought near the posterior ends of the aryteno-epiglottic folds; often, however, they will not be found. The two pyramidal **corniculate cartilages** should also be looked for; they are placed on the summits of the arytenoid cartilages within the aryteno-epiglottic folds.

The **cricoid cartilage** is shaped somewhat like a signet ring. The broad posterior part, the lamina, is quadrilateral. Its posterior surface is divided by a median ridge into two shallow concave areas, which give origin to the posterior crico-arytenoid muscles; to the ridge itself the longitudinal fibres of the œsophagus are attached by a strong tendinous band. On the upper border of the lamina there is an oval facet on each side of the middle line for articulation with the base of the arytenoid cartilage. The anterior part of the cartilage, the arch, is narrow in front, but its upper border rapidly ascends to the lamina. The arch is connected to the first ring of the trachea below by the crico-tracheal membrane, while the crico-thyreoid membrane (p. 186) is attached to its upper border. On each side there is a small round facet for articulation with the inferior cornu of the thyreoid cartilage (Fig. 64).

The **arytenoid cartilages**, which are to be left in position during the examination, are pyramidal in form, the apices being directed upwards while the bases articulate with the upper border of the lamina of the cricoid cartilage. Of the three surfaces of each cartilage, one looks medially towards the corresponding surface of the opposite cartilage; another looks posteriorly and gives attachment to the transverse part of the arytenoid muscle; while the third, the largest surface, faces antero-laterally and gives attachment to the thyreo-arytenoid muscle. These surfaces are separated by well-defined borders. At the base of the cartilage the lateral border is prolonged laterally and backwards in the form of a short prominent process, named the muscular process, to which the crico-arytenoid muscles are attached, while the anterior border is prolonged forwards as the vocal process and gives attachment to the vocal cord (Fig. 68).

The **crico-arytenoid joints** are of the diarthrodial variety. The movements which take place at them, as the dissector can readily demonstrate for himself, are of two kinds: (1) A gliding movement, by which the cartilages are carried bodily medially and laterally; the **arytenoid** muscle draws the cartilages together and thus the width of the glottis is lessened. (2) A rotatory movement, in which the arytenoid cartilages revolve round vertical axes. By this movement the vocal processes are swung medially and laterally so that the glottis is closed or opened. The **posterior crico-arytenoid** muscles, by drawing the muscular processes of the cartilages backwards and medially, swing the vocal processes and

the vocal cords laterally and thus open the glottis (Fig. 68). The **lateral crico-arytenoid** muscles act in the opposite direction; by drawing the muscular processes forwards they close the glottis (Fig. 68).

The muscles of the larynx also act during deglutition, for in that movement the aperture of the larynx is closed by the close apposition of the arytenoid cartilages and their projection forwards against the cushion of the epiglottis. The muscles chiefly concerned in this movement are the **thyreo-arytenoid**, the **arytenoid**, and the **aryteno-epiglottic** muscles.

The student should now make cardboard models of the cartilages of the larynx and articulate them together. In this way he can easily learn the action of the laryngeal muscles.

## THE NASAL CAVITIES

The parts of the mandible which still remain, together with the tongue and the larynx, must now be cut away from the upper part of the specimen, and on it the nasal cavities are to be dissected. The skull must be divided into two lateral parts by sawing through it vertically close to one side of the **nasal septum**. As a general rule the nasal septum is not placed quite in the median plane but deviates a little to one or other side, more frequently to the right. The direction which it takes in the skull under examination should be determined and the section should then be made close to its concave side. A knife is to be inserted into the nostril of that side and carried upwards through the cartilaginous part of the nose to the nasal bone, and the soft palate should be divided in the middle line. The section is to be completed by sawing through the hard palate a little to the required side of the median plane. Every care must be taken to preserve the septum of the nose intact.

The **nasal septum** divides the cavity of the nose into two chambers, the **nasal cavities**. As a rule it is not placed accurately in the median plane but almost invariably shows a deviation to one or other side; more frequently the deviation is to the right side. Immediately above the orifice of the nostril there is a slight depression on the septum. This part forms the medial wall of the **vestibule** of the nasal cavity (Fig. 61) and is covered with skin continuous with that of the exterior; it carries a number of stiff hairs named vibrissæ. Over the rest of its extent the nasal septum is covered with mucous membrane which is closely adherent to the subjacent periosteum, forming with it a muco-periosteum. Two

areas may be distinguished on the mucous membrane, namely, a lower **respiratory** area and a much smaller upper **olfactory** area. The mucous membrane of the respiratory area is thick, spongy, and highly vascular and contains numerous mucous glands, the minute orifices of the ducts of which can be detected with the naked eye. Over the olfactory area of the septum, which comprises not more than its upper third, the mucous membrane is not so thick and the glands are smaller; in the fresh state it is yellowish in colour.


FIG. 69.

*Diagram of the nasal septum.* The cribriform plate of the ethmoid bone should be named.

A minute opening in the mucous membrane may be found on the lower and anterior part of the septum, immediately behind the vestibular area. It leads into a narrow canal which passes a short distance backwards and ends blindly, and is of interest since it is the rudimentary representative of the organ of Jacobson (vomero nasal organ), a structure which is highly developed in most of the lower animals.

The muco-periosteum is to be stripped from the surface of the septum to expose the parts which enter into its formation. These parts are (Fig. 69) the vertical plate of the ethmoid and the vomer bone behind and the septal cartilage in front. Small parts of other bones, however, are also to be found in it. Thus, above and behind there are the crest and the rostrum of the sphenoid; above and in front is the nasal spine of the frontal bone; and below, along the

lower margin, there is the crest formed by the apposition of the palatal processes of the maxillary and palate bones of the two sides. The deviation of the septum from the median plane will probably be most marked along the line of union of the perpendicular plate of the ethmoid and the vomer.

The **septal cartilage** (Fig. 69) is a broad, irregularly four-sided plate. It fills the wide angular gap between the vertical plate of the ethmoid and the vomer, to each of which it is attached. In front and above, it is in contact with the suture between the two nasal bones. Below this it is related to the two lateral cartilages of the nose with the upper parts of which it is directly continuous, and still lower down it appears in the interval between the two alar cartilages (p. 11). The lower anterior border of the cartilage is free and extends backwards to the nasal spine of the maxilla (Fig. 69). The anterior angle is blunt and rounded; it does not reach to the point of the nose which is formed by the alar cartilages (p. 11).

The septal cartilage and the thin parts of the bones of the septum are now to be removed. This must be done very carefully and in small pieces, so as to preserve intact the muco-periosteum which covers the opposite side of the septum; for in it the **nerves** and the **vessels** of the septum are to be examined.

The **nerves** which are distributed in the septum are: (1) The **medial group** of **olfactory nerves** which are to be found in the olfactory area of the mucous membrane. They are difficult to discover, however, except in a fresh part, and are so soft that it is hardly possible to isolate them. They proceed upwards in grooves on the vertical plate of the ethmoid bone and enter the cranial cavity through the medial series of openings in the cribriform plate. (2) The **naso-palatine nerve**, a long slender twig, is easily found on the deep surface of the muco-periosteum, which it supplies. It arises from the spheno-palatine (Meckel's) ganglion (p. 206) and enters the nasal cavity through the spheno-palatine foramen. On the septum it passes downwards and forwards in a shallow groove on the surface of the vomer bone to the incisive foramen; and having passed through this opening the nerves of the two sides unite in a plexus from which branches are given to the mucous membrane of the anterior part of the hard palate. (3) A few **nasal** branches reach the back part of the septum from the spheno-palatine ganglion, while (4) the **medial nasal** branches of the anterior ethmoidal nerve (p. 136) are distributed over the anterior part of the septum as far down as the vestibule.

The **arteries** which supply the septum are: (1) The **posterior septal** branches of the spheno-palatine artery, which itself is the terminal branch of the internal maxillary artery. One of the septal branches, larger than the others, the **naso-palatine** artery, is distributed in company with the naso-palatine nerve; it can usually be discovered if the injection has been good. (2) Small branches are derived from the anterior and posterior ethmoidal arteries (p. 138). (3) The **septal** branch of the superior labial artery (p. 18) supplies the anterior part of the septum.

The muco-periosteum of the septum is to be cut away with scissors. The general shape of the nasal cavity and the structure of the lateral wall can now be examined on the two sides.

The **nasal cavities**, placed one on each side of the septum, are narrow from side to side; the width increases, however, from above downwards so that in transverse section the cavity of each side is somewhat triangular in shape. They open in front on the face through the anterior nares or the nostrils, and behind into the naso-pharynx through the posterior nares or choanæ. The roof of the nasal cavity is very narrow. When the mucous membrane which covers it is pulled away, it is seen to be formed in the middle by the cribriform plate of the ethmoid bone, through which the olfactory nerves may be seen to pass. In front of and behind the cribriform plate the roof slopes downwards; the anterior part is formed by the nasal spine of the frontal bone and the nasal bone, while the posterior part is formed by the anterior and under surfaces of the body of the sphenoid bone (Fig. 69). The floor of the nasal cavity is concave from side to side and slopes slightly downwards and backwards. It is formed by the palatal processes of the maxillæ and palate bones (Fig. 69). In its anterior part, just below the position of the organ of Jacobson, a depression of the mucous membrane into the incisive canal may be found; it is the vestige of an extensive communication between the cavities of the mouth and the nose which is present in the human embryo and in many of the lower animals.

The **lateral wall** of the nose is rendered uneven and folded over the greater part of its extent by the projection of the three **turbinal bones** (*conchæ*), superior, middle, and inferior, each of which overhangs a space called a **meatus** (Fig. 61). In front of the turbinal bones the lateral wall is smooth, and on it two areas, the **vestibule** and the **atrium**, can be recognised.

The **vestibule** is the depressed oval area immediately above the nostril; it is covered with skin which is continuous with that of the exterior and carries a number of short hairs, named vibrissæ. The **atrium** lies above the vestibular area and immediately in front of the middle meatus. It is slightly hollowed out, but at its upper part a flattened elevation, the **agger nasi**, runs downwards and forwards close to the nasal bone; the slight furrow above it, which leads to the olfactory area of the lateral wall, is named the **sulcus olfactorius**.

The **mucous membrane** which covers the lateral wall of the nasal cavity, with the exception of the vestibular area which is lined with integument, is closely blended with the subjacent

periosteum and forms with it a muco-periosteum. This is continuous with the mucous membrane of the pharynx behind and with the linings of the naso lachrymal duct and the various air-cells which open into the nasal cavity. As on the septum, there are two areas of the mucous membrane of the lateral wall, an upper **olfactory** area over the superior turbinal bone and a lower **respiratory** area which comprises the rest of the wall. The olfactory mucous membrane is soft and delicate, and in the fresh state is yellowish in colour, but the covering of the respiratory area, and especially over the middle and inferior turbinal bones, is thick and spongy. This condition is largely due to the presence of a venous plexus, which is best developed over the inferior turbinal and causes its mucous covering to be irregular and nodulated on the surface. The dissector should strip a small piece from the bone to appreciate its thickness. The mucous membrane everywhere contains numerous mucous glands, the minute orifices of which are visible to the naked eye.

The **nerves** which are distributed on the lateral wall of the nose are: (1) The **lateral group** of **olfactory nerves** which form a plexus in the mucous membrane over the superior turbinal bone. From this plexus about twenty filaments arise and pass upwards in grooves or canals in the bone and enter the cranial cavity through the lateral foramina of the cribriform plate. (2) The **posterior nasal nerves** are branches of the spheno-palatine ganglion and reach the nose through the spheno-palatine foramen. This opening will be exposed if the mucous membrane be stripped from the region just behind the posterior end of the middle turbinal bone. The naso-palatine nerve of the septum should be followed backwards into it, and then, by careful dissection, the delicate posterior nasal nerves may be found and traced to the mucous membrane over the upper and middle turbinals. (3) The **lateral nasal** branch of the anterior ethmoid nerve (p. 136) can be exposed in a groove on the deep surface of the nasal bone. It supplies the anterior part of the lateral wall. (4) Two small nasal branches are derived from the anterior palatine nerve (p. 206). They are distributed over the back parts of the middle and inferior turbinal bones.

The **spheno-palatine artery**, the terminal branch of the internal maxillary artery, is the chief vessel on the lateral wall of the nose, which it reaches by passing through the spheno-palatine foramen. Small twigs, which will hardly be found, are given off from the anterior and posterior ethmoidal arteries (p. 138) and the descending palatine artery (p. 183).

The **turbinal bones** and the **meatuses** covered by them are now to be examined. The **inferior turbinal** is the largest. It extends from the back part of the atrium to within half an inch of the opening of the Eustachian tube. Its lower free margin is somewhat convex and overhangs the **inferior meatus**. This passage is to be fully exposed by breaking the turbinal bone along its attached

border with a pair of scissors and turning it upwards (Fig. 70). In the anterior part of the meatus the opening of the **naso-lachrymal duct** (p. 9) will be found (Fig. 70). It varies greatly in its form. Sometimes it is a wide, circular aperture, in other specimens it is covered by a valvular flap of mucous membrane and difficult to detect; in these cases, if a probe be passed into the duct from the

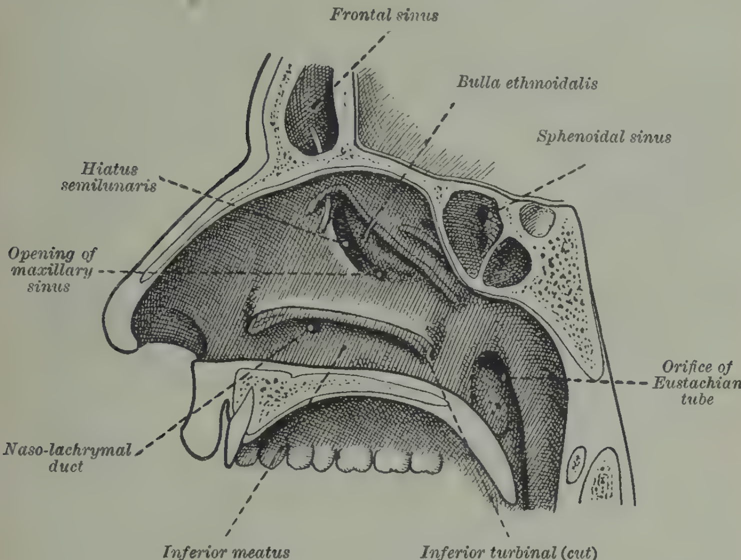


FIG. 70.

*A dissection of the lateral wall of the nose, the three turbinal bones being removed.* A bristle has been passed from the frontal air sinus through the infundibulum into the nose. Above the cut edge of the superior turbinal bone is the opening of the sphenoidal sinus.

lachrymal sac (p. 9), the opening will be demonstrated. The **middle turbinal** is a part of the ethmoid bone. Its free border begins below the anterior end of the cribriform plate and at first runs vertically downwards and then bending suddenly turns backwards. It should be turned forcibly upwards and backwards to bring into view the **middle meatus**, which lies between it and the inferior turbinal. On the lateral wall of the meatus a deep, crescentic groove, the **hiatus semilunaris** (Fig. 70), will be seen. It leads upwards into a funnel-shaped passage, the **infundibulum** (Fig. 70), which is the channel of communication between the

frontal sinus and the nasal cavity; while in its floor are the openings of the anterior ethmoidal cells and, at its posterior end, the opening of the maxillary sinus (antrum of Highmore) (Fig. 70). This sinus should be fully exposed from the lateral side by sawing through the zygomatic process of the maxilla, and it will then be seen that the orifice on its medial wall lies much nearer the roof than the floor of the cavity, a position highly unfavourable for the escape of inflammatory fluids which may collect in it. It should also be noted that if fluid be allowed to trickle from the frontal sinus through the infundibulum into the hiatus semilunaris it will pass into the maxillary sinus; there is a tendency, therefore, for the secretion of the former sinus to pass into the latter. Above the hiatus semilunaris there is a prominent globular swelling, the **bulla ethmoidalis** (Fig. 70); on or above it there is the aperture of the middle ethmoidal cells. The **superior turbinal**, also a part of the ethmoid bone, is very short. It is placed obliquely on the upper and posterior part of the lateral wall. It is continuous in front with the middle turbinal and it ends behind immediately below the body of the sphenoid bone. If it be turned aside with scissors, the **superior meatus**, a short narrow fissure, will be exposed; in its upper and anterior part is the opening (or openings) of the posterior ethmoidal cells. Above the superior turbinal there is, as a rule, a small triangular depression, the **spheno-ethmoidal recess.** It is bounded above by a small **fourth turbinal** bone (concha suprema), which joins the superior turbinal in front, and in its posterior part there is the opening of the sphenoidal air sinus (Fig. 70). This opening may be circular or be converted into a slit by a fold of mucous membrane.

## THE MAXILLARY NERVE

The **maxillary** (second) **division** of the **trigeminal nerve** is composed entirely of sensory fibres. It arises from the semilunar ganglion and runs forwards in the lateral part of the floor of the cavernous sinus to the foramen rotundum (p. 128), through which it enters the spheno-maxillary fossa. It crosses the upper part of this fossa, being directed a little laterally as well as forwards, and enters the infraorbital canal on the floor of the orbit. It traverses this canal as the **infraorbital nerve**, which appears on the face through the infraorbital foramen, where its terminal branches were secured (p. 19) and traced to the nose (nasal

branches), the lower eyelid (palpebral branches) and the upper lip (labial branches) (Fig. 71).

The course of the nerve is to be displayed from before backwards, by opening first the infraorbital canal and then removing as much of the lateral parts of the maxillary and sphenoid bones as is necessary to expose the spheno-maxillary fossa. This space is extremely restricted, but in it the **spheno-palatine ganglion** and

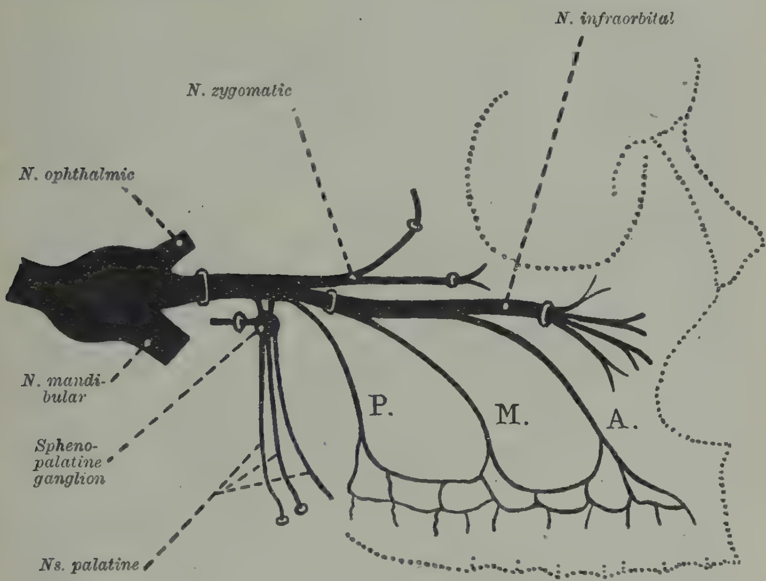


Fig. 71.

*A scheme of the maxillary nerve and its branches.* P, M, A. The posterior, middle, and anterior superior dental nerves.

the terminal part of the **internal maxillary artery** should be exposed.

In its course the maxillary nerve gives off the following branches (Fig. 71): (1) A small **meningeal** branch within the cranium. (2) Two **spheno-palatine** branches which descend in the spheno-maxillary fossa to the spheno-palatine (Meckel's) ganglion. (3) The **zygomatic nerve,** a small branch which enters the orbit by the spheno-maxillary fissure. It almost immediately divides into two branches, the zygomatico-temporal and zygomatico-facial nerves, which pass forwards on the lateral wall of the orbit

and, having traversed minute canals in the malar bone, appear on the face where they were previously secured. (4) The **superior dental nerves** are three in number, the **posterior** of which arises in the spheno-maxillary fossa and the **middle** and **anterior** from the infraorbital nerve (Fig. 71).

The **posterior superior dental nerve** divides into branches which run downwards on the posterior surface of the maxilla, and having given branches to the mucous membrane of the cheek and to the gum, enter the posterior dental canals and supply the molar teeth and the mucous membrane of the maxillary sinus. The **middle** and **anterior** nerves arise on the floor of the orbit and may be brought into view by gently raising the infraorbital nerve. They enter canals which descend on the lateral and anterior surfaces of the maxilla and supply, respectively, the bicuspid teeth and the canine and incisor teeth ; the anterior nerve also gives off a branch to the mucous membrane of the floor of the nose. The three dental nerves communicate with each other and form a looped plexus, from which the filaments to the teeth arise.

The **spheno-palatine** (Meckel's) **ganglion** is a small, flattened body which is embedded in soft fat and surrounded by the terminal branches of the internal maxillary artery in the spheno-maxillary fossa. It is connected to the maxillary nerve above by two **spheno-palatine** branches, but probably the majority of the fibres of these nerves pass through the ganglion into its nasal and palatine branches. It is also joined from behind by the **Vidian nerve** (nerve of pterygoid canal) which is formed by the union of the great superficial petrosal branch of the facial nerve (p. 130) and the great deep petrosal branch of the carotid plexus (p. 130). Considerable difficulty will be experienced in exposing the course of the nerve through the Vidian (pterygoid) canal. From the ganglion the following branches are given off: (1) **Orbital branches**, which pass forwards into the orbit ; they are exceedingly small. (2) **Posterior nasal nerves,** which form two groups, medial and lateral, and pass through the spheno-palatine foramen to, respectively, the septum and the lateral wall of the nose (p. 200 and p. 202). (3) The **palatine nerves** are three in number—anterior, middle, and posterior (Fig. 71). They arise from the lower aspect of the ganglion, as a rule, by a common trunk, which descends in the pterygo-palatine canal. The middle and posterior nerves are small ; they are distributed in the soft palate. The anterior branch is much larger. It enters the palate through the great palatine foramen and runs forwards in a groove on the under surface of the hard palate to the incisive foramen : it should be exposed there by reflecting the muco-periosteum. It supplies the mucous membrane and the glands of the roof of the mouth and communicates with the naso-palatine nerve in front.

The third part of the **internal maxillary artery** lies in the spheno-maxillary fossa, where it breaks into its terminal branches. These are : (1) The **posterior superior dental** artery (Fig. 30), which descends on the posterior surface of the maxilla and entering the posterior dental canals, supplies the molar and bicuspid teeth of the upper jaw and the gums. (2) The **infraorbital** artery which accompanies the infraorbital nerve on to the face where its terminal branches were secured. It also gives off the anterior superior dental artery which accompanies the nerve of the same name and supplies the anterior teeth. (3) The **descending palatine** artery enters the pterygoid canal and passes through the great palatine foramen into the oral surface of the hard palate. It is usually known

there as the great palatine artery, and runs forwards to the incisive foramen through which it passes into the nasal cavity and anastomoses with the vessels of the septum. In the upper part of the pterygoid canal it gives off the small palatine arteries, which are distributed to the soft palate, the pillars of the fauces, and the tonsil. (4) The **spheno-palatine** artery enters the nasal cavity through the spheno-palatine foramen, and divides into branches which are distributed on the lateral wall and on the septum (p. 202 and p. 200).

## THE BRAIN

It is practically essential, in order to understand the complex structure of the brain, that the student should dissect two brains; and if it has not been possible to procure a second brain from the post-mortem room, two groups of students should arrange to dissect together.

On the one specimen, the **general anatomy** of the **brain** should be examined first. To this end, the **membranes** and **blood vessels** which cover the brain should be completely removed. There will be considerable difficulty in doing this on the under surface of the brain and at the same time preserving intact the **cranial nerves** which are attached there; if, however, they are not grasped with forceps but are cleaned with scissors, it is quite possible to retain them entire (see Fig. 72).

When looked at from above, the brain appears an ovoid mass, the greatest transverse diameter of which is near the posterior end. The parts of the brain which are seen are the two highly convoluted **cerebral hemispheres**. They are separated from one another by a deep cleft, the **intercerebral** (great longitudinal) **fissure**, but if this fissure be opened the hemispheres will be seen to be connected together for about half their length by a large band, the **corpus callosum**.

The under surface, or the **base**, of the brain (Fig. 72) is remarkably irregular, yet it is more or less accurately adapted to the uneven base of the skull. On it the main subdivisions of the brain are to be recognised. The **medulla oblongata** is the short conical posterior part and is continuous in front with a more massive part, the **pons Varolii**, on the surface of which the fibres quite evidently run transversely. In the middle line of the medulla there is to be noted the **anterior fissure**; it ceases abruptly at the lower margin of the pons in a small pit, the **foramen cæcum**. On either side of this fissure and lying parallel with it, there is the eminence of the **pyramid**. This is larger at its upper than its lower part; for when followed downwards the fibres which form the pyramid cross the anterior fissure to the

opposite side. This **decussation** of the **pyramids** will be seen by opening up the lips of the anterior fissure and exposing the pyramids crossing one another as flattened bands (Fig. 72). Lateral to the upper part of each pyramid there is a second swelling of the medulla, oval in shape and about half an inch in length; it is named the **olive.** The area of the medulla behind the olive is the **restiform body**, which is easily followed upwards into the cerebellum as its inferior peduncle. The **pons** is much broader than the medulla, and the fibres seen on the surface run transversely. On either side these fibres are collected into a large compact bundle which sinks into the cerebellum; this bundle is named the **brachium pontis** or middle cerebellar peduncle. In the middle line of the pons there is a broad groove, which lodges the basilar artery and is named the **basilar groove.** The **cerebellum** is easily recognised. It is of considerable size, and its surface is traversed by closely set curved and parallel fissures. The pons and medulla are embedded in its under surface. Above the pons there is a deep hollow on the base of the brain, which is bounded at the sides by the **temporal** parts of the cerebral hemispheres. In it the following structures are to be recognised. The **crura** (or pedunculi) **cerebri** are two large grooved strands which emerge close together at the upper margin of the pons. As they proceed upwards they diverge from one another and each disappears into the corresponding cerebral hemisphere. As it passes into the hemisphere each crus is crossed by a flattened band, the **optic tract**; and if these tracts be followed forwards they are seen to converge and to be joined together by a short transverse portion, named the **optic commissure** or **chiasma.** From the optic chiasma the **optic nerves** run forwards and laterally (Fig. 72). The crura cerebri, the optic tracts, and the optic chiasma enclose a deep lozenge-shaped fossa, the **interpeduncular fossa**, in which there are to be seen: (1) The **corpora mammillaria** (or albicantia), two white bodies, resembling small peas, which are placed between the crura cerebri. (2) The **posterior perforated space**, which lies behind the corpora mammillaria in the angle between the crura cerebri. In it there are numerous small apertures which transmit blood vessels to deep parts of the brain. (3) The **tuber cinereum**, a raised rounded area, which lies behind the optic chiasma and in front of the corpora mammillaria (Fig. 72). Projecting from its anterior part there is a hollow funnel-shaped process, the **infundibulum**, which is attached by its extremity to the pituitary gland; in the removal of the brain, however, it was severed from that body which was left in the

sella turcica. In front of the optic chiasma the intercerebral fissure will be seen between the **frontal** portions of the cerebral hemispheres. If the anterior edge of the optic chiasma be raised, a thin membranous lamina will be found passing upwards from it into the intercerebral fissure. This is the **lamina terminalis.**

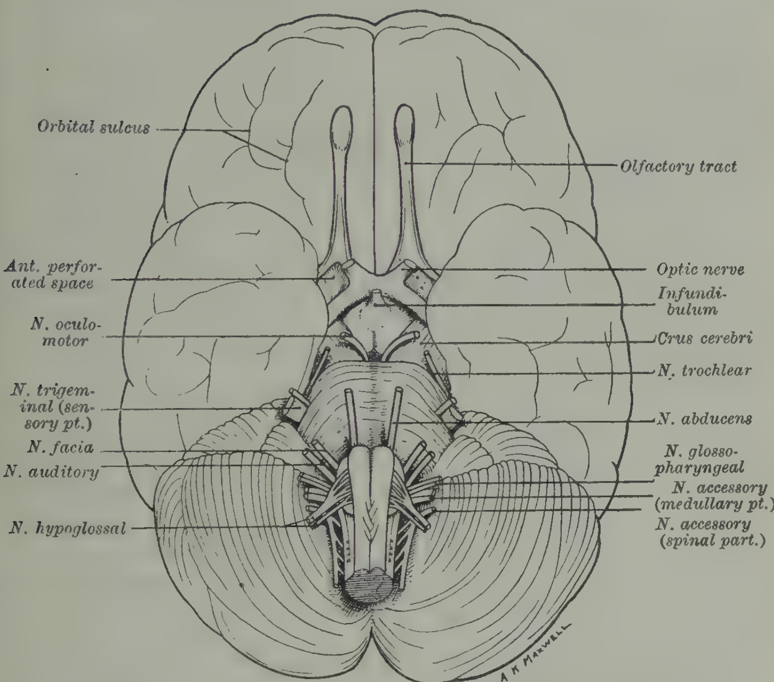


FIG. 72.

*Diagram of the base of brain.* The superficial attachments of the cranial nerves are shown. The student should recognise and name the different structures as they are described in the text on pp. 207-10; for example, the decussation of the pyramids and the corpora mammillaria.

On either side of the intercerebral fissure and lying on the surface of the frontal area, there is to be seen the **olfactory bulb** which is continued backwards into the **olfactory tract** (or peduncle); and if the tract be followed backwards it will be found to divide into two roots which diverge from one another (Fig. 72). Between these diverging roots, and limited medially by the optic chiasma and the optic tract, there is a triangular area of the brain surface

in which there are numerous apertures for the passage of small vessels. This area is the **anterior perforated space.**

The student must examine the base of the brain until he is quite familiar with all the parts which have been mentioned (Fig. 72).

Each **cerebral hemisphere** has a lateral, a medial, and an inferior surface, which are separated from one another by more or less definite borders. The lateral surface is full and rounded, and is moulded to the concavity of the cranial vault. The medial surface is flat and is opposed to the corresponding surface of the opposite hemisphere, the interval between the two being the longitudinal intercerebral fissure, which is in part occupied by the falx cerebri. The inferior surface is divided into anterior and posterior parts by the **lateral (Sylvian) fissure**, a deep transverse cleft which runs laterally from the region of the anterior perforated space (Fig. 72). The anterior, or orbital, area rests on the floor of the anterior fossa of the skull, while the posterior area lies in part on the floor of the middle fossa and behind this on the upper surface of the tentorium cerebelli. The tentorial area of the inferior surface is quite distinctly concave.

The surface of the cerebral hemispheres is characterised by the presence of **convolutions** or **gyri** separated from one another by **fissures** or **sulci.** The general arrangement of these convolutions and fissures is much the same in all human brains, but in details there are very marked differences in different individuals, and even in the two hemispheres of the same brain. They will be studied in detail later, but at present one of them, the **lateral (Sylvian) fissure,** is to be examined, and, of course, on both sides.

The **lateral fissure** (of **Sylvius**) is the most conspicuous cleft on the surface of the cerebral hemisphere. It is composed of a short main **stem** which lies on the base of the brain and a series of **branches** on the lateral surface. The stem begins close to the anterior perforated space and runs almost transversely laterally as a deep furrow between the orbital surface in front and the pole of the temporal region behind. Appearing on the lateral surface of the hemisphere, the fissure divides into three (sometimes only two) branches (Fig. 77). (1) The **posterior ramus,** the longest and the most constant, extends backwards and slightly upwards on the lateral surface of the hemisphere for a distance of two or three inches. It intervenes between the temporal region which lies below it and the frontal and parietal regions which lie above it; and it ends by turning upwards into the parietal region in the form of an ascending terminal part. (2) The **anterior horizontal ramus** extends almost horizontally forwards into the frontal region for a distance of about one-half or three-quarters of an inch. (3) The **anterior ascending ramus,** which is inconstant, proceeds upwards and slightly forwards into the lower part of the frontal region for a distance of somewhat less than an inch.

The two anterior rami of the Sylvian fissure are most commonly independent of one another, U- or V-form, as is described above and shown in Fig. 77; but almost as frequently they may arise by a common stem from the main fissure, Y-form, or be represented by a single limb, I-form.

The Sylvian fissure is really formed by the coming together of the edges of a great fossa on the lateral surface of the hemisphere, and it is different in this respect from the other cerebral furrows. If the

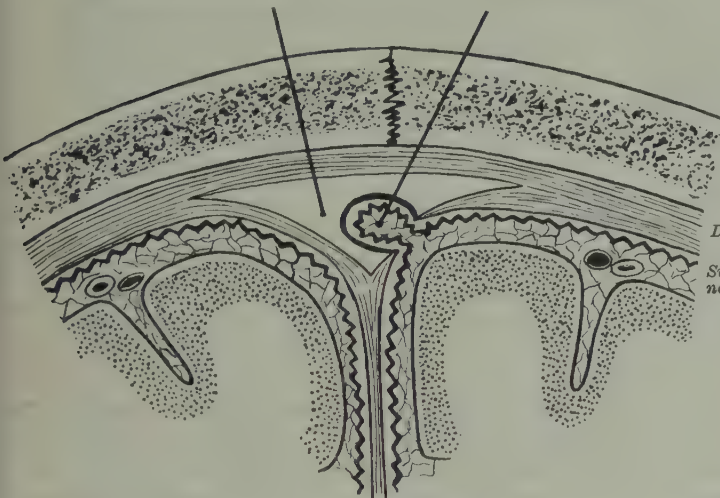


Fig. 73.

*The arrangement of the meninges of the brain is shown diagrammatically.* The thickness of the dura mater is exaggerated, but it is to be noted how it is thinned over the Pacchionian body; the arachnoid is shown as a thick waved line and the pia mater as a continuous line over the stippled cortex of the brain; the position of the blood vessels should be observed.

lips of the fissure be separated, therefore, they will be seen to be large, lid-like folds which roof over the floor of the fossa and hide it from a surface view (Fig. 81). The floor of the fossa, which is moulded into convolutions like the rest of the surface of the hemisphere, is named the **insula** or the island of Reil.

The student must now turn to the second brain, and on it examine the cerebral coverings and the cerebral blood vessels, which are still intact.

The brain, like the spinal cord, is enclosed within three membranes, which collectively are termed the **meninges**, and are

named individually, from without inwards, the **dura mater**, the **arachnoid**, and the **pia mater**. The cerebral dura mater, which lines the bony walls of the cranial cavity and forms partitions between the major parts of the brain, has already been studied (p. 120), and it remains now to examine the arachnoid and the pia mater which invest the brain more closely.

The **arachnoid** is a very thin and transparent membrane which is wrapped round the brain somewhat loosely, so that, with the exception of the intercerebral and Sylvian fissures, it does not dip into the sulci on the surface of the brain. It bridges over the inequalities of the brain, and in this respect it differs from the pia mater (Fig. 73). The **pia mater** is also a delicate membrane but is very highly vascular. It follows closely all the inequalities on the surface of the brain, and on the cerebral hemispheres it dips into each fissure in the form of a fold (Fig. 73): on the cerebellum, however, it only dips into the larger fissures.

The interval between the arachnoid and the pia mater is the **subarachnoid space**. This space is crossed by a meshwork of fine trabeculæ which connects the two membranes intimately together. Over the summit of the cerebral convolutions the arachnoid is in close contact with the pia, and the trabecular meshwork is dense, so that it is hardly possible to separate the two layers from one another. In the intervals between the convolutions, however, the arachnoid will be seen to separate itself from the pia, and as it bridges over these spaces, it can be readily recognised and the trabecular tissue can be studied (Fig. 73). The subarachnoid space contains the cerebro-spinal fluid and is traversed by the larger branches of the cerebral arteries and veins, the walls of which are connected with the trabecular tissue.

Over certain parts of the brain the arachnoid is separated from the pia mater by intervals of greater extent. These expanded portions of the subarachnoid space are named **cisternæ**, and here the subarachnoid tissue is much reduced and in the form of long filamentous threads. All the cisternæ communicate freely with one another and with the narrow spaces on the surface of the hemispheres. Some of the larger cisternæ round the base of the brain require special mention. Their position should be identified on the first brain while they are being opened up on the second.

The **cisterna cerebello-medullaris** is the largest of all, and is formed by the arachnoid bridging over the wide gap between the under surface of the cerebellum and the posterior surface of the medulla oblongata. The **cisterna pontis** lies round the front of the pons and medulla, and

is continuous on either side of the medulla with the cerebello-medullary cistern. The stem of the brain, therefore, is completely surrounded by a wide subarachnoid space. The **cisterna interpeduncularis** is formed by the arachnoid bridging over the interpeduncular fossa, and in it there will be seen the large arteries which supply the cerebral hemispheres. Leading out from this cisterna there are two wide spaces, the **cisternæ laterales**, which are prolonged into the lateral (Sylvian) fissures, and a third space, the **cisterna chiasmatis**, extends in front of the optic chiasma and is continued into the intercerebral fissure.

**Pacchionian bodies** (arachnoid granulations).—It will be remembered that a number of small fleshly-looking bodies were seen on the surface of the dura mater on each side of the superior longitudinal sinus, and that when this sinus was opened they were also found projecting into its lumen (Fig. 73). These are the Pacchionian bodies, and it was then described that though they may appear to belong to the dura mater they are in reality arachnoid granulations. Each granulation is attached to the arachnoid by a narrow stalk, and contains an extension of the subarachnoid space and its trabecular tissue. The granulations do not pierce the dura mater, but remain covered by a thinned layer of this membrane, even when it may appear that they project freely into the blood sinuses (Fig. 73). As the granulations enlarge they produce small fossæ on the inner surface of the cranial vault for their lodgment, though they do not come in contact with the bone. The granulations serve to transmit cerebro-spinal fluid from the subarachnoid space into the venous sinuses. In the child they are small, but as age advances they become large and conspicuous.

The blood vessels of the brain are now to be examined. The larger trunks are placed in the subarachnoid space, surrounded by the cerebro-spinal fluid, and it is in the cisternæ on the base of the brain that the main arteries are to be exposed, as is described below, by the removal of the covering arachnoid. The **arteries of the brain** are derived from four great trunks, the two **vertebral** and the two **internal carotid arteries**, all of which were divided in the course of the removal of the brain.

The cut ends of the **vertebral arteries** should be secured first. These vessels are branches of the subclavian arteries, and were previously traced through the transverse processes of the cervical vertebræ, across the floor of the suboccipital triangle, and through the dura mater between the atlas and the occipital bone. They then enter the skull through the foramen magnum, and having pierced the arachnoid, lie one on each side of the medulla oblongata. As it passes forwards each artery inclines to the anterior surface of the medulla, and at the lower margin of the pons the two vessels unite with one another to form the **basilar artery**. This artery passes along the basilar groove in the middle line of the pons, and at its anterior border bifurcates into the right and left **posterior cerebral arteries** (Fig. 74). These vessels turn backwards round the crura cerebri on to the under surface of the cerebral hemispheres.

The **internal carotid artery** of each side has already been traced as far as the anterior clinoid process of the sphenoid bone, at which level it was divided in the removal of the brain. On the base of

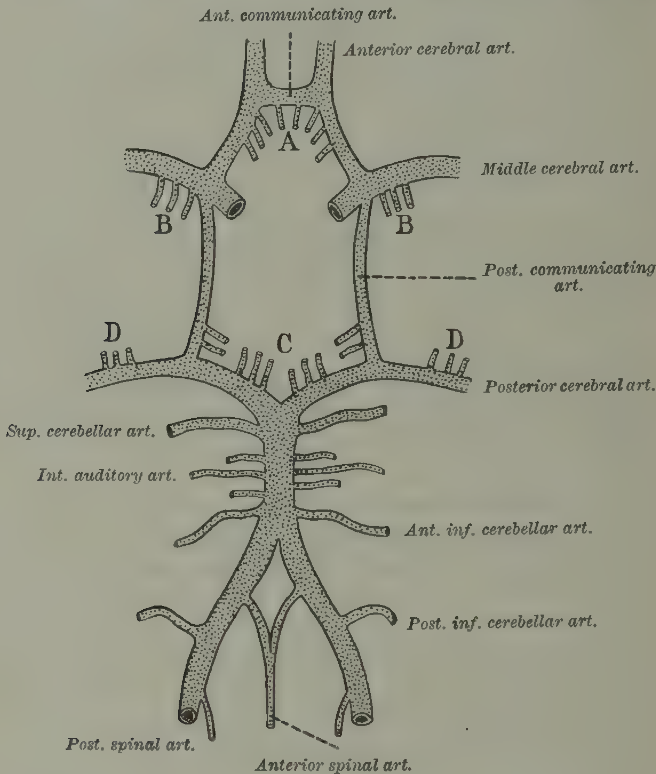


FIG. 74.

*The arrangement of the arteries on the base of the brain and the formation of the circle of Willis.*

A. Antero-medial, B. Antero-lateral, C. Postero-medial, and D. Postero-lateral central arteries.

the brain the cut end of the vessel is to be secured on the lateral side of the optic chiasma and close to the medial end of the stem of the lateral fissure. It pierces the arachnoid there and almost at once divides into its two terminal branches, the **anterior** and **middle cerebral arteries** (Fig. 74). The anterior artery is the smaller vessel and runs forwards and medially *above* the optic chiasma (above, when the base of the brain is turned downwards), and

enters the intercerebral fissure. The two anterior vessels are there connected with one another by a short transverse stem, the **anterior communicating artery**. The middle cerebral artery, the larger branch and the more direct continuation of the parent stem, passes laterally into the Sylvian fissure in which it is conducted to the lateral surface of the hemisphere. Near its termination each internal carotid artery (sometimes the middle cerebral artery) gives origin to the **posterior communicating artery**. This vessel runs backwards below the optic tract and on the surface of the crus cerebri and joins the posterior cerebral artery (Fig. 74). These vessels constitute a free anastomoses between the carotid and vertebral systems of cerebral arteries, and complete a remarkable connection between the vessels on the base of the brain, which is termed the **circle** of **Willis**. This circle is irregularly polygonal in outline (Fig. 74), and is formed in front by the anterior communicating and anterior cerebral arteries, and then, in succession, by the internal carotid, posterior communicating, posterior cerebral, and basilar arteries. This direct communication between the cerebral trunks is almost constant, though irregularities in the size of the different vessels are often met with, and is probably of importance in equalising the flow of blood to the different parts of the cerebrum.

The **branches** which arise from these large trunks for the most part spread themselves over the surface of the brain in the subarachnoid space; but after their subdivision the finer twigs enter the pia mater and ramify in it before entering the substance of the brain. On the cerebral hemisphere, these vessels are named the **cortical branches**, and they carry with them, into the brain, sheaths of the pia mater. They are well seen, as fine filaments, if a piece of pia mater be very carefully raised from the surface of the hemisphere. They supply the grey cortex of the cerebrum, and, it should be noted, that since these vessels anastomose freely in the pia mater, the blood supply of neighbouring areas of the cortex is not sharply demarcated. The cerebral hemispheres have distributed to them, however, a second system of branches, named the **central** or **basal branches**. These are a large number of slender twigs which arise in groups from the cerebral arteries and the circle of Willis, and pierce the base of the brain, especially at the anterior and posterior perforated spaces. They supply the central parts of the brain, and they differ from the cortical branches in that they do not anastomose with one another. They belong, therefore, to the class of "end arteries." There is a third group of branches

of the cerebral arteries, named the **choroidal branches**, distributed in the choroid plexuses of the various ventricles of the brain. They cannot be seen at present, but will be studied at a later period.

The details of the branches of the arteries of the brain which the student should dissect are as follows:—

**Branches of the vertebral artery** (Fig. 74).—In the intracranial part of its course the vertebral artery gives off: (1) The **posterior spinal artery**, which passes down the spinal cord in front of the posterior nerve roots. More frequently, probably, this artery is a branch of the posterior inferior cerebellar artery. (2) The **posterior inferior cerebellar artery** which is the largest branch. It is a tortuous vessel and passes backwards round the upper part of the medulla, among the roots of the hypoglossal and vagus nerves and then over the restiform body, to the under surface of the cerebellum. It divides there into two branches, the medial of which is distributed in the notch between the cerebellar hemispheres and the lateral on the posterior part of the under surface of the hemisphere. Branches from this artery supply the choroid plexus of the fourth ventricle. (3) The **anterior spinal artery** arises near the lower border of the pons. The two vessels, usually of unequal size, converge as they descend on the front of the medulla and unite with one another at the level of the foramen magnum. The median vessel thus formed extends downwards on the spinal cord. (4) The **medullary branches** are several minute vessels which spring from the vertebral artery and its branches and are distributed to the substance of the medulla oblongata.

**Branches** of the **basilar artery** (Fig. 74).—The branches of the basilar artery pass laterally from either side of the vessel, and comprise: (1) The **pontine arteries**, numerous small twigs running transversely on the surface of the pons and entering its substance. (2) The **internal auditory artery**, a long slender vessel which accompanies the auditory nerve into the internal auditory meatus and supplies the internal ear. It will be found among the pontine branches. (3) The **anterior inferior cerebellar artery** passes backwards to the anterior part of the under surface of the cerebellar hemisphere where it is distributed. It anastomoses with the posterior vessel. (4) The **superior cerebellar artery** arises near the bifurcation of the basilar artery. It is a large vessel and runs laterally and backwards below the oculo-motor nerve and then winds round the crus cerebri to reach the upper surface of the cerebellum. It divides there into a large number of branches which spread out over the surface and at its margins anastomose with the branches of the inferior cerebellar arteries. (5) The **posterior cerebral arteries.**

The course and distribution of the three **cerebral arteries** are to be studied with particular care, and the student is reminded that from them three systems of branches arise, namely, the **cortical**, the **central**, and the **choroidal** arteries. To facilitate the dissection, the whole brain is to be divided into lateral halves by a median section. A large brain-knife is to be used, and the brain being laid base downwards, it is to be entered in the middle line of the intercerebral fissure and the whole brain cut through with one

sweep of the knife. If the student is in any doubt at all, the assistance of a demonstrator should be sought as it is important that the brain should be accurately divided.

The **posterior cerebral arteries** are the two terminal branches of the

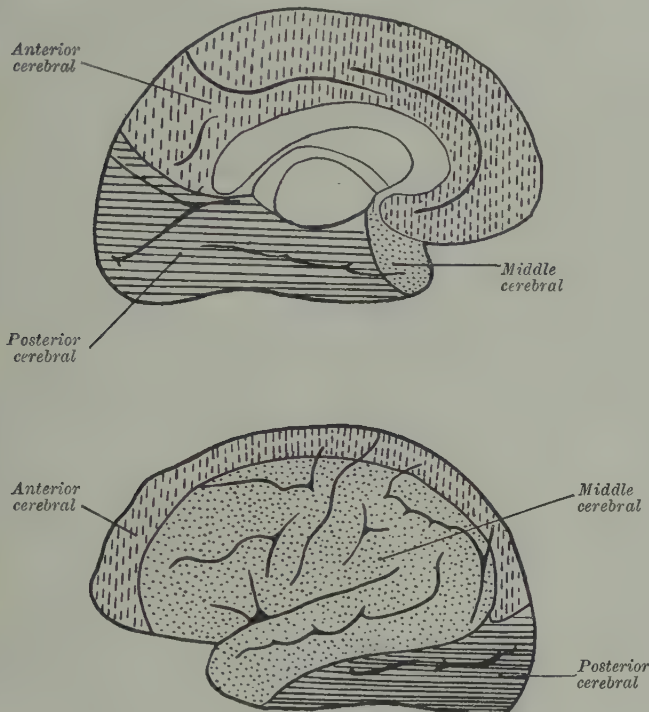


Fig. 75.

*Diagrams to show the areas of distribution of the cortical arteries.* The student should examine very carefully the areas of the hemisphere supplied by each of the three cerebral arteries. The upper figure shows the medial and under surfaces, and the lower figure the lateral surface.

basilar artery. Each vessel runs laterally and backwards parallel to the superior cerebellar artery, from which it is separated by the oculo-motor nerve, and curving round the crus cerebri reaches the under surface of the cerebral hemisphere. It distributes a large number of branches to this surface of the cerebrum and is continued backwards beneath the posterior end of the corpus callosum where it sinks into the calcarine fissure. Its branches are as follows :—

1. The **cortical branches** (Fig. 75) are distributed to the under surface

of the temporal region (temporal arteries), and the medial and under surfaces and the posterior part of the lateral surface of the occipital region (calcarine and parieto-occipital arteries. These vessels follow the fissures from which they are named, and it should be observed that the calcarine branch supplies the visual area of the cerebral cortex).

2. The **central branches** (Fig. 74) form two groups. The postero-median vessels arise on the base of the brain and pierce the posterior perforated space. They supply the posterior part of the thalamus and the medial parts of the crus. The postero-lateral branches arise on the lateral side of the crus, and supply the corpora quadragemina, the geniculate bodies, and the posterior part of the thalamus.

3. The **posterior choroidal arteries** are a set of small branches which enter the velum interpositum and end in the choroid plexus of the lateral ventricles.

The **anterior cerebral artery** is the smaller of the terminal branches of the internal carotid artery. It runs forwards, as already described, to the anterior part of the intercerebral fissure, being joined, in this part of its course, to the opposite vessel by the anterior communicating artery. It then turns round the anterior end of the corpus callosum and is continued backwards on the medial surface of the hemisphere as far as the parieto-occipital fissure. Its branches are as follows :—

1. **Cortical branches** (Fig. 75) are distributed to the medial part of the under surface of the frontal region (orbital branches) and to the medial surface of the hemisphere as far back as the parieto-occipital fissure (medial frontal branches). These branches turn round the upper margin of the hemisphere and supply the adjacent parts of the lateral surface.

2. The **central branches** (Fig. 74) form the antero-median group which pass into the base of the brain in front of the optic chiasma. They supply the anterior part of the corpus callosum, the head of the caudate nucleus and the anterior parts of the lentiform nucleus and the internal capsule.

The **middle cerebral artery**, the larger of the two terminal branches of the internal carotid artery and the more direct continuation of it, passes laterally into the stem of the Sylvian fissure. Remaining in the depth of the fissure, it reaches the surface of the island of Reil, where it divides into a large number of branches. These branches emerge from between the lips of the Sylvian fissure, and spreading out over the hemisphere supply the greater portion of its lateral surface (Fig. 75). The branches of distribution are :—

1. The **cortical branches** which supply the lateral surface of the frontal, parietal, and temporal regions (frontal, parietal, and temporal arteries), and near the margins of the hemisphere anastomose with the branches of the anterior and posterior cerebral arteries.

2. The **central branches** (Fig. 74) are the antero-lateral central arteries. They arise on the base of the brain close to the anterior perforated space, and may be grouped in two sets, known as the medial and the lateral striate arteries. The medial striate vessels pass upwards through the medial parts of the lentiform nucleus and the internal capsule and end in the caudate nucleus. They supply the anterior parts of the nuclei and the anterior part of the internal capsule. The lateral striate arteries pass upwards through the lateral part of the lenticular nucleus or through the external capsule, and bend medially through the lenti-

form nucleus to the internal capsule and caudate nucleus. They are divisible into two groups, anterior and posterior, the former being arranged in a definite row; and one of these is larger than its companions, and being the most frequent seat of rupture of all the cerebral arteries, has been named the "artery of cerebral hæmorrhage."

The **anterior choroidal artery** is a small branch which arises from the internal carotid artery close to its termination. It passes backwards to the lower part of the choroidal fissure where it terminates in the choroid plexus of the inferior horn of the lateral ventricle.

The **veins** of the brain are arranged in two sets, namely, the **superficial** veins which lie on its surface, in the pia mater and the subarachnoid space, and the **deep** veins which issue from its substance. The terminal trunks of both sets pierce the arachnoid and the cerebral layer of the dura mater and end in the cranial venous sinuses. The cerebral veins do not possess valves. It is not usual to undertake a detailed dissection of these veins, but the following main facts regarding them should be studied:—

The deep veins of the **medulla** issue from its substance and end in the superficial veins. These form a plexus in which an anterior and a posterior median trunk are the main vessels. It communicates with the veins of the spinal cord below, and is drained by small lateral veins which run with the roots of the last four cranial nerves and end in the inferior petrosal sinus or in the bulb of the internal jugular vein.

The deep veins of the **pons** issue on its anterior surface where they join the plexus of the superficial veins. These drain into the basal vein (see below) or enter the superior petrosal sinus.

The deep veins of the **cerebellum** terminate in the superficial veins. These lie on the upper and lower surfaces of the cerebellum quite separately from the arteries. They end the median vessels which join the great cerebral vein (see p. 242) or the straight sinus and in lateral vessels which pass to the lateral and petrosal sinuses.

The deep veins of the **cerebral hemisphere** will be examined during the dissection of the brain. The superficial veins are of large size and are more numerous than the arteries. They form two sets, the superior and the inferior. The superior veins lie on the upper and lateral aspects of the hemisphere and run upwards towards the superior sagittal sinus in which they terminate. It has already been observed that the posterior veins of this set run obliquely forwards for some distance in the wall of the sinus and that their orifices are directed forwards against the blood stream. The inferior veins lie on the lateral and inferior surfaces of the hemisphere and terminate in the sinuses on the base of the skull. There are very constant members of this group in the lateral (Sylvian) fissure (middle cerebral veins) and accompanying the anterior cerebral artery (anterior cerebral vein), and these, or some of them, join with one another on the base of the brain close to the anterior perforated space to form the **basal vein**. This vein passes backwards and round the crus cerebri to terminate in the great cerebral vein (see p. 242).

The membranes and blood vessels should now be removed from the two halves of the brain, and special care should again be

exercised to preserve the cranial nerves which are attached on the base. It is advisable, indeed, to leave the membranes undisturbed on the medulla and pons on account of their relation to the roof of the fourth ventricle, which is otherwise certain to be damaged.

The **superficial origins** of the **cerebral nerves**.—There are twelve pairs of nerves attached to the brain, and each of these nerves is described to have a "deep" and a "superficial" origin. The "deep" origin refers to the group of cells within the substance of the brain with which the fibres of the nerve are connected. This group of cells is referred to as the "nucleus of the nerve." The several nuclei will be, of course, of two kinds, namely, the "sensory nuclei" round which the sensory or ingoing nerve fibres end, and the "motor nuclei" from which the motor or outgoing fibres arise. The "superficial" origin of the nerve refers to the point at which the nerve fibres enter or leave the surface of the brain, and it is these points of superficial attachment which are to be studied at the present time (Fig. 72). The brain which is still entire should be used for this purpose and reference made to the sectioned brain to confirm the findings established there.

The **olfactory** (first) **nerves** are not readily seen. They extend from the nasal cavity to the under surface of the olfactory bulb, which they reach by passing through the foramina in the cribriform plate of the ethmoid bone.

The **optic** (second) **nerve** is a large round trunk which passes forwards and laterally from the optic chiasma (Fig. 72).

The **oculo-motor** (third) **nerve** will be found in the interpeduncular fossa and can be followed to its attachment on the medial side of the crus cerebri at the oculo-motor groove.

The **trochlear** (fourth) **nerve** leaves the brain on its dorsal aspect, behind the corpora quadragemina. Its point of attachment cannot be seen at present, but it is readily recognised as a delicate nerve which winds round the lateral side of the crus cerebri.

The **trigeminal** (fifth) **nerve** is a bulky nerve which emerges from the lateral surface of the pons, somewhat nearer the upper than the lower border. It consists of two roots, a large sensory root, the fila of which are loosely bound together, and a small compact motor root which lies on the medial side (Fig. 72).

The **abducent** (sixth) **nerve** emerges in the groove between the lower border of the pons and the lateral part of the pyramid of the medulla.

The **facial** (seventh) **nerve** is attached to the lower border of the pons immediately above the restiform body. It has two roots, the larger motor root lying on the medial side of the smaller sensory root. The two roots join one another in the internal auditory meatus.

The **auditory** (eighth) **nerve** lies immediately on the lateral side of the seventh nerve. It has two parts, named the cochlear and vestibular parts, and these embrace the restiform body.

The **glosso-pharyngeal** (ninth), **vagus** (tenth), and **accessory** (eleventh) **nerves** are formed from a continuous row of rootlets which are attached to the medulla in the groove between the olive in front and the restiform

body behind. These rootlets extend, in linear series, along the whole length of the medulla, and passing laterally become grouped in three sets which unite to form, from above downwards, the ninth, tenth, and eleventh nerves. The eleventh nerve, however, has a second part, which springs from the spinal cord as low down as the level of the sixth cervical nerve by a series of rootlets which are attached to the cord behind the ligamentum denticulatum. The spinal part of the nerve ascends in the vertebral canal and enters the skull through the foramen magnum to join the medullary part (p. 130).

The **hypoglossal** (twelfth) **nerve** is formed from a series of fila which are attached to the medulla between the olive and the pyramid. These fila form a linear series continuous with those of the anterior root of the first cervical nerve, but between the two sets of rootlets the vertebral artery passes forwards to the front of the medulla.

The general relations and connections of the several parts of the brain should now be very carefully studied on the medial face of the sectioned brain, the student examining Fig. 76 until he is able to recognise on the brain the various structures which are indicated. It will be noted that in each of the several parts there is a very definite cavity, and it can now be understood that the various parts of the brain may well be considered to be the walls of these cavities. It will then be observed that the walls vary very much in their thickness, at some places, for example at the pons, being very thick, and at others, for example at the superior medullary velum, being very thin (Fig. 76).

The medulla, the pons and the cerebellum, which compose the hind-brain, will be seen to form the boundaries of a tent-shaped cavity, the **fourth ventricle** (Fig. 76). The medulla and pons form the anterior wall or the floor of the cavity, and the cerebellum, which is now seen to be formed of a central core of white matter overlaid everywhere by a mantle of grey matter, lies in the roof. It forms, however, only a small part of the actual roof, which consists mainly of the **superior medullary velum** above the cerebellum and a very thin epithelial lamina below the cerebellum. The medulla and pons are seen to be, in the main, continuous with one another, but the **restiform body** of the medulla and the **brachium pontis**, which is formed by the gathering together of the transverse fibres of the pons, are to be followed backwards into the cerebellum. The cavity of the fourth ventricle when followed downwards is continued into the **central canal** of the spinal cord, and when followed upwards is continued into the **aqueduct of Sylvius** (aqueductus cerebri), which tunnels through the mid-brain (Fig. 76). Behind the aqueduct lie the **corpora quadragemina**, while in front of it and forming its floor, there is the thick mass of the **crus cerebri**, which quite obviously constitutes the connection

between the cerebral hemisphere in front and the hind brain and spinal cord behind. The aqueduct of Sylvius opens in front into a narrow and rather irregularly shaped cavity, the **third ventricle.** The side walls of the third ventricle are formed by the two **thalami** ; the anterior wall is formed by the **lamina terminalis,** which should be followed upwards to the **anterior commissure,** a distinct rounded bundle of white fibres (Fig. 76); and in the floor of the ventricle there are to be recognised, from before back-

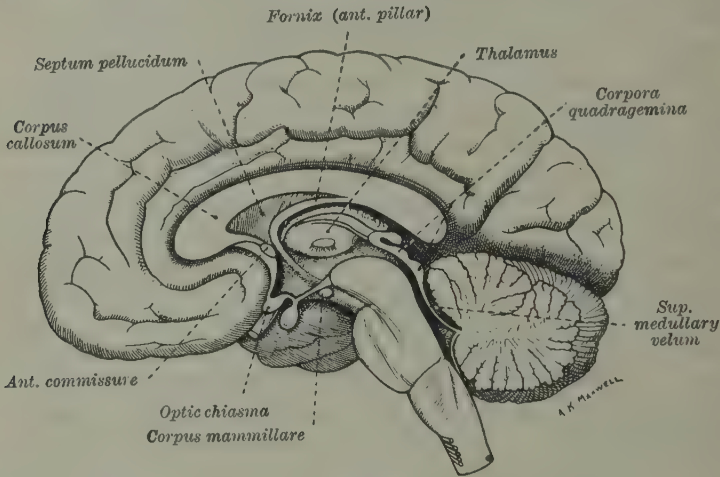


FIG. 76.

*Diagram of the medial face of the sectioned brain.* The various structures which are described in the text, on pp. 221-3, are to be identified, for example, the fourth ventricle and the lamina terminalis.

wards, the **optic chiasma**, the **infundibulum**, and one of the **corpora mammillaria**. The **pineal body** is also to be identified ; it projects backwards from the third ventricle so as to overlie the upper corpora quadragemina and will be found to be more or less embedded in a mass of pia mater (Fig. 76). Near the anterior end of the third ventricle there will be seen just in front of the thalamus the **foramen** of **Monro** (foramen interventriculare). This opening leads into the corresponding **lateral ventricle**, that is, the cavity of the cerebral hemisphere. It cannot be seen, however, at the present stage of the dissection. On the medial wall of the cerebral hemisphere there should be recognised: (1) The **corpus callosum** in longitudinal section. It is an arched white

band, thick and rounded at its posterior part (the **splenium**), and at its anterior end bending on itself (the **genu**), and running backwards as a much thinned part (the **rostrum**) to the anterior commissure (Fig. 76). (2) The **fornix**, which can be identified as the anterior boundary of the foramen of Monro, and followed backwards over the upper surface of the thalamus to the under surface of the splenium of the corpus callosum to which it is adherent. (3) The **septum pellucidum**, a thin membrane, which fills up the interval between the corpus callosum above and the fornix below, to both of which it is attached. If the brain has not been sectioned in the middle line the septum pellucidum will be absent on one side and the lateral ventricle will be opened.

## THE CEREBRAL HEMISPHERE

Each of the different parts of the brain is now to be studied in detail. The **cerebral hemisphere** is to be taken first, and that all of its surface may be fully exposed, on one-half of the sectioned brain the mid-brain is to be cut through, and the pons, medulla, and cerebellum separated from the cerebrum.

The cerebral hemisphere is characterised, as already stated, by a complex pattern of fissures and convolutions on its surface, which, in its main features at least, the student must endeavour to understand from the purely topographical aspect. This having been done, however, it is to be noted that while it is usual to subdivide the surface of the hemisphere into lobes by the so-called **interlobar fissures** and to redivide the lobes by **intralobar fissures**, that this is entirely artificial and an arbitrary proceeding; it is useful only from the topographical aspect, and the student will remember much more about the brain if, rather, he constantly relates what is known of its function with its different parts.

The great majority of the fissures appear along the boundary lines between areas of the surface which are different in structure. A second group, however, comprises the fissures which occur in areas of uniform structure, while a third group, which includes the lateral fissure (of Sylvius), depends on some more mechanical factor. By means of the fissures the area of the surface of the hemisphere is very markedly increased in proportion to its mass.

The more important fissures and the related areas of the brain, all of which the student should learn to locate by examining all the material at his command, are as follows:—

The **lateral Sylvian** or **fissure** has already been described (p. 210), but it should be studied again now. If the lips of the posterior branch of the fissure be widely separated from each other, the area of cortex which is hidden from view when the fissure is closed will be seen. This area, named the **insula** or **island of Reil,** will be observed to be triangular in outline and to be surrounded by a limiting sulcus, the **sulcus circularis insulæ.**

The **sulcus circularis** consists of three parts, an upper horizontal part from the ends of which a vertical part descends in front, and an inferior oblique part runs downwards and forwards behind. The **insula** is thus marked off from the neighbouring regions of the hemisphere, except at its antero-inferior apical part where the sulcus circularis is deficient. At this part (limen insulæ) the insula comes into close relation with the anterior perforated space on the base of the brain. The surface of the insula is divided by an oblique fissure (sulcus centralis insulæ) into two parts, anterior and posterior, each of which is usually subdivided into smaller gyri by secondary sulci.

The parts of the cerebral hemisphere which overlap the insula are termed the insular **opercula,** and they form, by the apposition of their margins, the three branches of the Sylvian fissure. The opercula are four in number and are easily distinguished (Fig. 77).

The **temporal operculum** extends upwards over the insula from the temporal region. Its upper margin forms the lower lip of the posterior ramus of the Sylvian fissure. The **fronto-parietal operculum** covers the insula from above, extending downwards from the frontal and parietal regions to meet the temporal operculum. The **frontal operculum** is the small triangular field which intervenes between the ascending ramus and the anterior horizontal ramus of the Sylvian fissure. It is sometimes named the "pars triangularis." The **orbital operculum** lies below the anterior horizontal ramus of the Sylvian fissure and, for the most part, on the under surface of the hemisphere. It projects backwards over the anterior part of the insula from the orbital area of the frontal region.

The **central fissure** of **Rolando** (sulcus centralis) is the second fissure to be examined (Fig. 77). It lies on the lateral surface of the hemisphere, across which it takes an oblique course and intervenes between the frontal region in front and the parietal region behind. The upper end of the fissure cuts the upper border of the hemisphere a short distance (half an inch) behind the mid-point between the frontal and occipital poles, and as a rule it is carried a little way downwards on the medial surface (Fig. 78). Its lower end terminates above the middle of the posterior branch of the Sylvian fissure.

The **fissure of Rolando** (Fig. 77) forms an angle of about 70° (approximately three-quarters of a right angle), with the upper border of the

hemisphere ; and it may be mapped on the scalp by drawing a line three and a half inches long downwards and forwards at this angle from a point half an inch behind the mid-point between the gabella and the external occipital protuberance (Fig. 51). While the general direction of the sulcus may be thus indicated, it is far from being straight. Its course across the hemisphere is sinuous. Near its upper end there is usually a well-marked bend backwards, which is commonly named the upper genu. If the fissure be widely opened up, it will often be seen

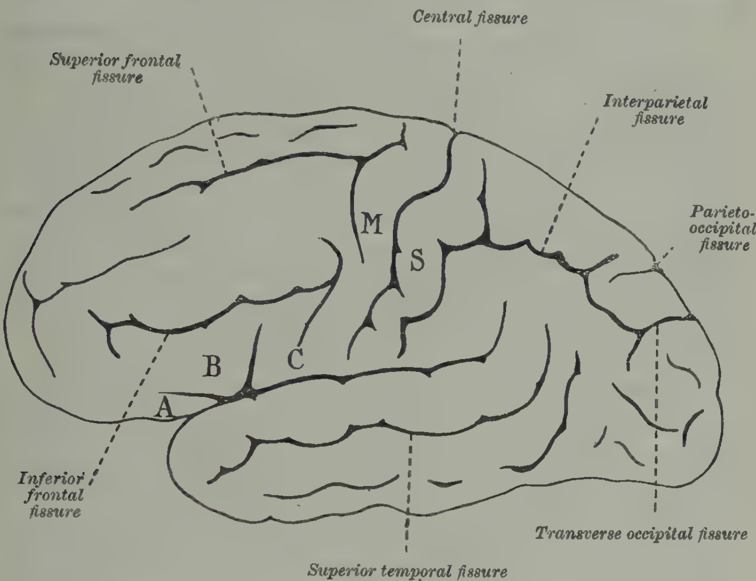


FIG. 77.

*A diagram of the lateral surface of the cerebral hemisphere.* The main fissures only have been drawn, and the student should name the convolutions related to them.

M. Precentral gyrus. S. Postcentral gyrus. A. Pars orbitalis, B. Pars triangularis, and C. Pars basilaris of the inferior frontal gyrus.

that its continuity is interrupted by a sunken connection between its anterior and posterior walls : this is termed a deep annectant gyrus.

The **frontal region**, so far as it may be limited, lies in front of the Rolandic (central) fissure on the lateral surface of the hemisphere and in front of the stem of the Sylvian (lateral) fissure on the under surface. On the medial surface it extends to the corpus callosum. A series of fissures, which are somewhat variable, break up these surfaces. On the orbital surface (Fig. 72) there are two fissures, the **olfactory sulcus** which lodges the olfactory bulb

and tract, and lateral to it the **orbital sulcus** which assumes many different forms.

The **olfactory sulcus** is a straight furrow which lies parallel to the medial border of the hemisphere. The narrow strip which lies on its medial side is named the **gyrus rectus.** The **orbital sulcus** is a compound fissure of variable form, but most commonly it is H-shaped. It subdivides the lateral part of the orbital surface into a number of small **orbital gyri.**

On the lateral surface of the frontal region the **precentral** (anterior central, pre-Rolandic) **convolution** should be identified first (Fig. 77). It is the long continuous gyrus which lies immediately in front of the whole length of the Rolandic fissure and is limited anteriorly by the **superior** and **inferior precentral sulci.** It should be examined carefully and its relations to the surface of the head should be considered, for it includes the **motor area** of the cerebral cortex. In front of the pre-central convolution, the frontal region may be divided into **superior, middle,** and **inferior frontal convolutions,** which are arranged horizontally and separated from one another by the **superior** and **inferior frontal sulci** (Fig. 77).

The **superior precentral sulcus** is a short vertical fissure which lies in front of the upper part of the central fissure. Almost invariably the **superior frontal sulcus** runs horizontally forwards from it. The **inferior precentral sulcus** consists of a vertical portion which lies in front of the lower part of the central fissure, and an oblique portion which runs upwards and forwards from it. Not infrequently one or other of these portions is confluent with the **inferior frontal sulcus,** which runs more or less horizontally forwards to the margin of the hemisphere, close to which it ends in a terminal bifurcation.

The three **frontal convolutions** are further intersected, often by numerous small fissures, but it is only the subdivision of the **inferior** of them which requires to be studied, since there is localised within it, on the left side, the **motor** part of the group of cortical areas which constitute the centres for **speech.** It is intersected by the two anterior branches of the Sylvian fissure, which subdivide its lower portion into three parts. The pars orbitalis lies below the anterior horizontal ramus, the pars triangularis is included between the anterior and ascending rami, while the pars basilaris is that part between the ascending ramus of the Sylvian fissure and the vertical part of the precentral fissure (Fig. 77). It is traversed by a shallow fissure, the sulcus diagonalis. The pars triangularis and that part of the pars basilaris in front of the sulcus diagonalis, that is the convolution which is moulded round the ascending limb of the Sylvian fissure, is often named the convolution of Broca.

On the medial surface of the frontal region (Fig. 78) there are two convolutions, a larger peripheral one which is continuous with the superior frontal gyrus over the margin of the hemisphere, and a smaller inner **gyrus cinguli** which encircles the corpus callosum. They are separated by the **sulcus cinguli.**

The **sulcus cinguli** (calloso-marginal fissure) is a well-marked fissure on the medial surface of the brain. It commences below the genu of the corpus callosum and, curving parallel to that body, it runs at first upwards and then backwards. Finally it turns upwards and ends by cutting the superior margin of the hemisphere a little way behind the central fissure (Rolando). Almost constantly a branch of the sulcus runs upwards in front of the Rolandic fissure, and the part of the frontal region which lies between it and the terminal piece of the sulcus is named the **paracentral convolution.** The central fissure partially divides it into two parts, the anterior of which is part of the precentral motor gyrus (Fig. 78).

The lateral surface of the **parietal region** lies behind the fissure of Rolando and above the fissure of Sylvius (Fig. 77). On it there should be identified first the **postcentral** (post-Rolandic) **convolution,** which extends across the hemisphere immediately behind the central (Rolandic) fissure and is limited posteriorly by the **superior and inferior postcentral sulci.** This gyrus includes within it the cortical **area** of **tactile sensations.** The remainder of the parietal surface is divided into **superior** and **inferior parietal convolutions** by a horizontally running sulcus, which with the postcentral sulci completes the **interparietal sulcus.**

The **interparietal sulcus** (of Turner) (Fig. 77) is composed of four distinct parts which may become united in a variety of ways. The **superior** and **inferior postcentral sulci** lie behind the upper and lower parts of the central fissure, and may or may not be continuous with one another ; they form the posterior boundary of the postcentral convolution. From the upper end of the inferior sulcus the **ramus parietalis** of the interparietal sulcus extends backwards and slightly upwards, and may be continued into the **ramus occipitalis.** More frequently, however, the latter is a separate fissure which runs backwards into the occipital region, where it ends in a transverse fissure, the **sulcus occipitalis transversus** (Fig. 77).

The **superior parietal convolution** lies above the ramus parietalis, and the **inferior convolution** below it. The latter area comprises three arched gyri. The anterior of these, the **supramarginal gyrus,** is bent round the upturned end of the Sylvian fissure ; the middle, named the **angular gyrus,** surrounds a fissure which is sometimes confluent with the superior temporal sulcus ; and posterior to this and separated from it by a transverse sulcus there is the **post-parietal gyrus.**

The **occipital region** of the hemisphere should be examined next. On its medial surface there are two deep fissures, the **parieto-occipital fissure** above and the **calcarine fissure** below ; and these become confluent with one another in front so that together they form a ≺-shaped figure (Fig. 78). The triangular area which lies between these fissures is named the **cuneus** ; and the area in front of this is the **precuneus** and the area behind the **gyrus lingualis.**

The **parieto-occipital fissure** (Fig. 78) is a deep cleft which lies almost vertically on the medial surface of the occipital region. Its upper end cuts the superior border of the hemisphere about two inches above the occipital pole, and is continued on the lateral surface for about half an inch; the lower end of the fissure joins the calcarine fissure. If it be widely opened up, however, it will be seen that the junction is only superficial, for a deep annectant gyrus will be exposed crossing between its walls and separating it from the calcarine fissure.

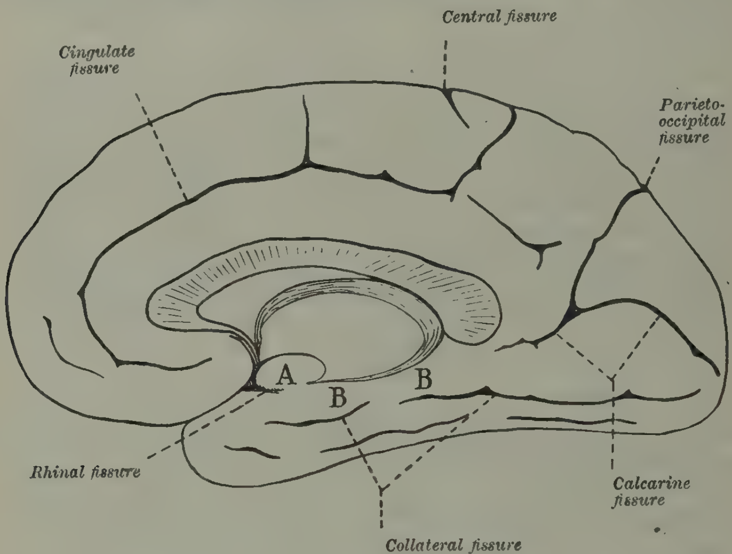


FIG. 78.

*A diagram of the medial surface of the cerebral hemisphere.* The main fissures only have been drawn and the student should name the convolutions related to them. The corpus callosum and the fornix should be identified.

A is the uncus and B B the posterior part of the hippocampal gyrus.

The **calcarine fissure** commences below the splenium of the corpus callosum and takes a curved course backwards to the occipital pole, close to which it bifurcates. If the fissure be opened up, however, so that its floor is exposed, it will be seen to be divided into two parts by a deep annectant gyrus crossing from the anterior part of the cuneus to the gyrus lingualis. The anterior part of the fissure is very deep, and corresponds with an elevation on the wall of the lateral ventricle which is named the **calcar avis**. The posterior part of the fissure is much shallower; the cortex which forms its walls is the **visual sensory area.**

The **precuneus**, somewhat quadrilateral in form, lies between the parieto-occipital fissure and the upturned end of the cingulate fissure. It is imperfectly marked off below from the gyrus cinguli by a variable **sub-parietal sulcus** (Fig. 78).

On the **lateral surface** of the **occipital region** only two fissures are to be defined (Fig. 77). These are: (1) The **pars occipitalis** of the interparietal sulcus, which has already been described to terminate in a transverse (vertical) fissure named the **sulcus occipitalis transversus**; and (2) the **sulcus occipitalis lateralis**, a short horizontal fissure which very imperfectly divides the surface into an upper and a lower area.

On the **inferior surface** of the occipital region there is to be identified the **collateral fissure** (Fig. 78). It begins near the occipital pole and runs forwards towards the temporal pole. Posteriorly it lies below and parallel to the calcarine fissure, being separated from it by the **gyrus lingualis**, and further forwards the **hippocampal gyrus** lies on its medial side (Fig. 78).

The **collateral fissure** does not reach the margin of the temporal pole, though it sometimes becomes confluent with a shallow sulcus which separates the anterior end of the hippocampal convolution from the temporal pole; this sulcus is named the **rhinal fissure** or the **incisura temporalis** (Fig. 78).

The **gyrus lingualis** (Fig. 78) lies between the calcarine and collateral fissures. It commences at the occipital pole and runs forwards into the hippocampal gyrus. It lies partly on the medial and partly on the tentorial surface of the hemisphere.

The **temporal region** of the hemisphere is that part which lies behind the stem of the Sylvian fissure, its anterior end forming the prominent temporal pole on the under surface of the brain. On the lateral surface of the hemisphere it is limited above by the posterior branch of the Sylvian fissure, while on the under surface it extends medially to the collateral fissure. On the **lateral surface** there should be identified the **superior temporal fissure**, a deep cleft which begins near the temporal pole in front and runs backwards parallel to the posterior branch of the Sylvian fissure. At its posterior end it turns upwards into the parietal region where it is surmounted by the gyrus angularis (Fig. 78). Below the superior fissure, the surface of the temporal region is interrupted by an irregular series of furrows which are classified together as the **middle temporal fissure.**

The **middle temporal fissure** consists of an irregular number of isolated fissures arranged in series one behind the other, midway between the superior temporal fissure and the lower margin of the hemisphere The most posterior of the series turns upwards into the parietal region and intervenes between the angular gyrus in front and the post-parietal gyrus behind (Fig. 78).

The lateral surface of the temporal region is divided by these two fissures into three horizontal convolutions, the **superior, middle,**

and **inferior temporal gyri**; and in the uppermost of these, about its middle and close to the Sylvian fissure, lies the cortical **centre of hearing**.

On the **inferior surface** of the temporal region there are a variable number of furrows lying parallel to the collateral fissure near the margin of the hemisphere. They are grouped together as the **inferior temporal fissure**, and serve to subdivide this area of the temporal region into a lateral part which is continuous with the inferior temporal gyrus, and a medial part, limited by the collateral fissure, which is named the **gyrus fusiformis** (Fig. 78).

The **hippocampal gyrus** is the most medial convolution on the tentorial surface of the hemisphere (Fig. 78). Posteriorly, under the splenium of the corpus callosum, the calcarine fissure cuts into it and divides it into two parts; the lower of these is continuous with the gyrus lingualis, and the upper with the gyrus cinguli. The hippocampal gyrus and the gyrus cinguli are sometimes included together as the **gyrus fornicatus**.

It has already been stated (p. 220) that the **olfactory nerves** enter the under surface of the **olfactory bulb**. They terminate in the bulb, and it remains now to examine the connections which are formed by the olfactory bulb through the **olfactory tract**. These connections are small and in great part rudimentary in the human brain and at the present stage of the dissection some of them cannot be seen; as far as he can, however, the student should follow the description given below.

The **olfactory bulb** (Fig. 72) is a small, flattened, oval mass of grey matter which lies in the sulcus olfactorius on the under surface of the frontal region of the hemisphere. When the brain is in position, the olfactory bulb rests on the cribriform plate of the ethmoid bone and receives the olfactory nerves. Its posterior end is attached to the rest of the hemisphere by the **olfactory tract**, a narrow prismatic band of white matter which runs backwards in the sulcus olfactorius. At the anterior end of the anterior perforated space the olfactory tract broadens and then appears to divide into two roots which diverge from one another. At the point of divergence a small ovoid area of grey matter, the **olfactory tubercle**, can sometimes be seen, but as a rule it cannot be distinguished from the anterior perforated space. The lateral root, which is the continuation backwards of the olfactory tract, passes almost transversely laterally across the limen insulæ, and ultimately ends in the anterior end of the hippocampal convolution. This part of the hippocampal gyrus is known as the **uncus** (Fig. 78); it is limited laterally by the rhinal fissure and forms the definite, recurved, hook-like extremity of the gyrus. Connected with the uncus there will afterwards be seen the **fascia dentata** which is the receptive centre for impressions of smell.

The surface of the cerebral hemisphere having now been examined, a study of the structure of its interior is to be commenced. The undivided brain is to be used in this dissection. It is to be placed

base downwards, and with a large brain-knife the right hemisphere is to be cut through horizontally at about the level of the cingulate fissure, and the top portion removed. The cerebral hemisphere is now seen to be composed of an inner core of white matter and an outer coating of grey matter. The white matter is named the **medullary centre.** It consists of medullated nerve fibres which may be classified in three distinct groups according to the connections which they establish. These groups are: (1) **Association fibres** which link together different portions of the cortex of the same hemisphere; (2) **commissural fibres** which connect the cortex of one hemisphere to the cortex of the opposite hemisphere; and (3) **projection fibres** which pass between the cerebral cortex and other parts of the central nervous system, for example, the pons or the spinal cord. The grey coating of the hemisphere is termed the **cerebral cortex.** It will be observed to be spread in a continuous layer over the entire surface of the hemisphere, though it is not of equal thickness in all localities: over the top of a convolution, for example, it is usually thicker than at the bottom of a fissure. The structure of the cortex cannot be studied in the dissecting-room, but it is to be stated that there are marked differences in regions of different functional associations, for example, between the motor area and the sensory areas. One of these areas, the visual centre (see p. 228), is so characteristic in its appearance that it should be examined by making a vertical section through the occipital pole. The cortex round the posterior part of the calcarine fissure will then be seen to have running through it, parallel to the surface, a white band which is termed the **stria of Gennari**; and it is to be understood that this is a characteristic only of the area of the cerebral cortex which is associated with the reception of sight impressions.

The substance of the right hemisphere is now to be removed down to the level of the upper surface of the **corpus callosum.** This is to be done by scraping with a blunt knife or by gently tearing away the brain matter in a lateral direction; but if the dissection is being performed for the first time it is advisable to have the assistance of a demonstrator. As the white substance of the gyrus cinguli is being removed, an attempt should be made to define a well-marked and distinct longitudinal band which is embedded in it. This is the **cingulum.**

The **cingulum** is a well-defined band of white fibres which is embedded in the white centre of the gyrus cinguli, but from which it can be easily separated. It begins in front in the region of the anterior perforated space, and curves round the anterior end, over the upper surface, and round the posterior end of the corpus callosum, and ends in the hippo-

campal gyrus. The cingulum is an association bundle, the easiest of the whole series of association tracts for the student to dissect, and is formed by several systems of fibres which run only short distances within it.

The dissection which has been carried out on the right hemisphere is to be repeated on the left side, so that the whole upper surface of the **corpus callosum** is exposed; and it will now be distinctly seen that this body is formed by a great mass of commissural fibres uniting the two hemispheres. It is to be studied at the same time on the medial face of the sectioned brain.

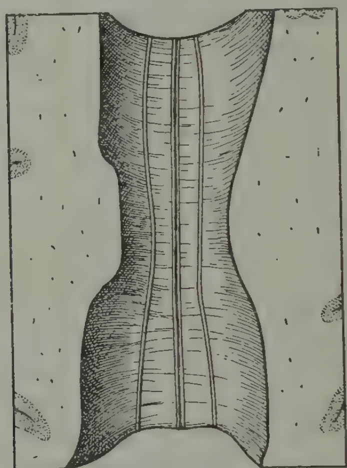

Fig. 79.

*The upper surface of the corpus callosum with the striæ longitudinales.*

The **corpus callosum** is the great commissural tract of the cerebral hemispheres, being formed by transverse fibres connecting the cortices of opposite sides. As seen on medial section (Fig. 76), it is highly arched from before backwards, and is placed a little nearer the anterior than the posterior end of the brain. It unites the hemispheres for about half their length. The posterior end, full and rounded, is named the **splenium**; it is the thickest part of the corpus callosum. The intermediate part, termed the **body**, is much thinner, while the anterior end which is bent downwards and backwards on itself, is called the **genu.** The part which extends backwards from the genu is the **rostrum**; it thins rapidly and ends as a fine band of neuroglial tissue which fuses with the lamina terminalis just above the anterior commissure.

The upper surface of the corpus callosum (Fig. 79) is about an inch wide. It forms the bottom of the intercerebral fissure in the middle line and is covered on each side by the cingulate gyrus. It is coated with a very thin layer of grey matter, in which there are on either side of the middle line two longitudinal bands of fibres, the **striæ longitudi-**

**nales medialis** and **lateralis**. The medial stria is the more distinct; it is close to the middle line and is separated from that of the opposite side only by a faint groove. The grey lamina with the striæ is often termed the **gyrus supracallosus**, and it represents an abortive part of the area of the hemisphere associated with the sense of smell. It is prolonged round the splenium of the corpus callosum into the **fascia dentata** and anteriorly is continued round the genu as the **gyrus subcallosus**, which, as a faint ridge, descends from the rostrum and passes towards the anterior perforated space.

The transverse fibres of the corpus callosum are easily seen through the coating of grey matter. As they enter the white substance of each hemisphere they spread out so as to reach most parts of the cerebral cortex. The most anterior of them, which pass through the genu, curve forwards into the frontal region; they form the "forceps minor." The most posterior which pass through the splenium bend abruptly backwards into the occipital region; they form a very definite bundle named the "forceps major." The intermediate fibres are transverse and those which pass through the posterior part of the body form a compact stratum called the "tapetum," which roofs the posterior horn of the lateral ventricle and bending downwards forms its lateral wall and that of the inferior horn (Fig. 83).

The **lateral ventricle**, the cavity of the cerebral hemisphere, is to be opened on each side by cutting away the corpus callosum which forms the roof of its upper part. A longitudinal incision should be made through the corpus callosum on each side of the middle line, the two incisions to be about a quarter of an inch apart from one another. The central part of the corpus callosum, which lies between these incisions, is to be kept in position, but the lateral parts are to be gradually cut away until the ventricles are opened into. The fibres which form the forceps major do not require to be removed. It is the anterior and central parts of the ventricles which will have been opened, and they should be exposed as fully as possible and a good view obtained of their interior by cutting away as much of the roof as is necessary. The lateral ventricle, however, also extends backwards into the occipital region and downwards into the temporal region, and these parts should be exposed on one side of the brain. The posterior horn can be opened by gradually removing the medullary substance which forms its roof, but it is more difficult to make the dissection of the temporal horn. It is best done by first cutting away the temporal operculum of the insula and then gradually removing the lateral wall of this part of the ventricle, commencing behind where it can be seen to join the central part and working forwards into the temporal region. A sufficient amount of the lateral wall must be removed to give a good view of the cavity. The direction of the dissection corresponds very closely with the course of the superior temporal fissure.

The walls of the **lateral ventricle**, which are now exposed, are smooth and shining, for they are lined by a thin epithelial layer which is named the **ependyma**. On the medial side of each ventricle, and near its anterior end, a rounded opening should be sought; it is the opening through which the lateral ventricle communicates with the third ventricle, and is named the **foramen of Monro** or **interventricular foramen**. The shape of the lateral ventricle is very irregular, and for descriptive purposes it is divided

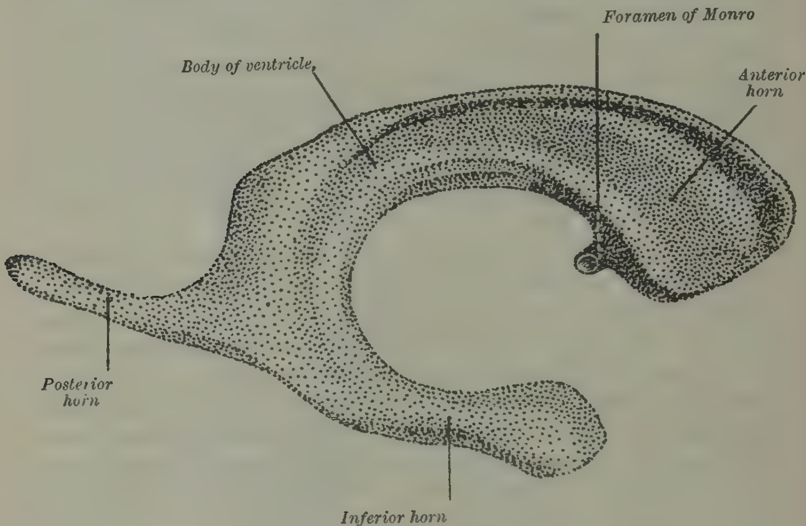


FIG. 80.

*The lateral ventricle viewed from its lateral side.* The shape of the ventricle and its different parts are shown.

into four parts, namely, a central part or body and three horn-like processes which lead from it, an anterior, a posterior, and an inferior (Fig. 80). The **anterior** horn is that part which lies in front of the foramen of Monro. The **body** of the ventricle extends from the foramen of Monro to the splenium of the corpus callosum, at which point the posterior and inferior horns diverge from it. The **posterior** horn, very variable in its length, curves backwards and medially into the occipital region, while the **inferior** horn passes downwards and forwards in the temporal region. These different parts are to be examined in detail, and at the same time vertical sections made at appropriate places through the hemisphere which was previously detached should be studied.

The **anterior horn** extends forwards and laterally into the frontal region as far as the genu of the corpus callosum. When examined on a vertical section made half an inch behind the genu (Fig. 81), it is triangular in outline, the floor sloping upwards and laterally to meet the roof. The roof is formed by the anterior part of the corpus callosum, the medial wall is vertical and consists of the septum pellucidum, while in the floor there is a smooth rounded bulging which is the anterior end of the caudate nucleus.

The **body** of the ventricle is also roofed by the corpus callosum and its medial wall is formed by the posterior part of the septum pellucidum. On its floor there are to be recognised: (1) On the lateral side and in front, the caudate nucleus, which narrows rapidly as it passes backwards from the floor of the anterior horn; and (2) on the medial side and to some extent behind, the upper surface of the thalamus. These two bodies are separated by a groove which is directed backwards and laterally, and in it there are to be identified a white band, the stria terminalis, and the vein of the corpus striatum, the vena terminalis. This vein runs forwards to the foramen of Monro and there joins the internal cerebral vein. Lying on the upper surface of the thalamus there is readily recognised the choroid plexus of the lateral ventricle. It is a highly vascular fold of pia mater which appears to lie free within the ventricle, but it is to be borne in mind that it is covered by the ependyma which excludes it from the cavity (Fig. 82). Posteriorly the choroid plexus is carried into the inferior horn of the ventricle while anteriorly it reaches as far as the foramen of Monro. Above the choroid

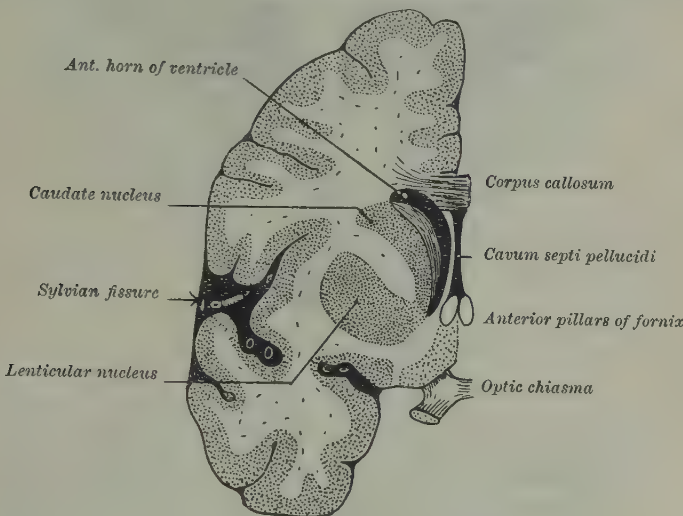


FIG. 81.

*Vertical section through the cerebral hemisphere half an inch behind the genu of the corpus callosum.* The form and position of the anterior horn of the lateral ventricle are to be studied. The island of Reil is seen at the bottom of the Sylvian fissure.

plexus there is to be seen the thin, sharp, lateral edge of the fornix, from under which the plexus projects. A vertical section made through the centre of the thalamus will show the structures forming the walls of the ventricle as diagrammatically represented in Fig. 82.

The **posterior horn** describes a gentle curve, convex laterally, in its course into the occipital region. The roof and the lateral wall of this


FIG. 82.

*A diagram of a vertical section through the bodies of the lateral ventricles.* The lateral ventricles (the two triangular areas in solid black) are roofed by C.C. the corpus callosum. They are separated from one another by the septum pellucidum (two heavy lines) which descends from the corpus callosum to the fornix (a triangular area). Below the fornix is the velum interpositum (a solid black line), the edges of which project into the ventricles as the choroid plexuses. It is to be noted that the plexuses are covered by the ependyma of the ventricles (a waved white margin), which excludes them from the actual cavities. In the floor of each ventricle is the caudate nucleus C and the thalamus T, and in the groove between them the stria and the vena terminalis. Between the thalami is the third ventricle (in solid black). Its roof is formed by the velum interpositum from which two choroid plexuses project into the cavity.

part of the ventricle are formed by the tapetum of the corpus callosum, which is well seen in vertical sections through the splenium as a thin but distinct layer of white matter immediately outside of the ependymal lining (Fig. 83). On the medial wall there are two elongated elevations. The upper is named the bulb of the cornu and is produced by the forceps major fibres of the splenium of the corpus callosum as they curve into the occipital region. The lower swelling is the calcar avis ; it corresponds with the anterior part of the calcarine fissure but is very variable in its size.

The **inferior horn** of the lateral ventricle passes downwards behind the thalamus into the temporal region, and in it it extends forwards

and medially to about an inch behind the temporal pole. The lateral wall is formed by the tapetum of the corpus callosum. In the roof, at the extremity of the horn, there is a bulging into the cavity. This is produced by a small mass of grey matter named the amygdaloid nucleus, and there will afterwards be followed forwards to it, in the roof, the stria terminalis and the tail of the caudate nucleus. On the floor of the horn (Fig. 84) the dissector will see first the choroid plexus, which is continuous behind the thalamus with the choroid plexus of the body of the ventricle. If it be turned aside, the hippocampus which it covers will be seen. This is a well-marked elevation, curved like the ventricle itself so that its medial margin is concave and the lateral margin convex. It is narrow posteriorly but expands as it passes forwards and it ends

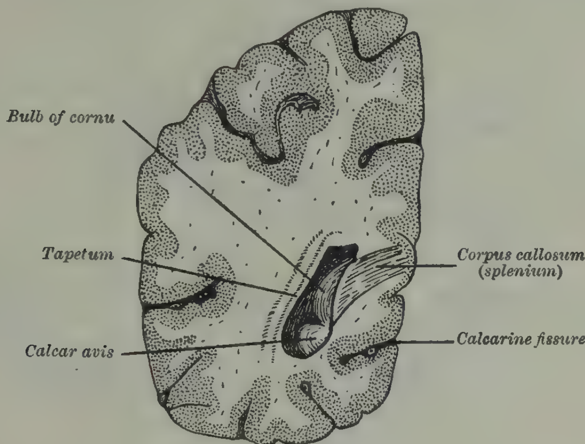


FIG. 83.

*Vertical section of the cerebral hemisphere through the posterior horn of the lateral ventricle.*

in front in a thickened extremity. The surface of this part is marked by two or three faint grooves, and is named the pes hippocampi (Fig. 85). Attached to the medial concave border of the hippocampus there is a very distinct though narrow band of white matter. It is named the fimbria, and the white fibres which form it are continuous with the white layer, the alveus, which is spread over the surface of the hippocampus though it is not easily distinguished. The fimbria will afterwards be seen to be continued into the fornix. On the lateral side of the hippocampus there may be a smooth swelling, the eminentia collateralis, and this may be continued backwards into the interval between the hippocampus and the calcar avis. It corresponds to the collateral fissure, but there are very great differences in its development. In a vertical section through the inferior horn the arrangement of the structures described above will be seen as diagrammatically represented in Fig. 84.

The remains of the temporal region should now be detached from the hemisphere so that the floor of the inferior horn can be

more closely studied. This is easily done by cutting through the forceps major and the fimbria behind and the temporal pole in front. The hippocampus and the fimbria are now seen to lie above, and a little on the lateral side of the hippocampal gyrus of the temporal region (Fig. 84). The medial edge of the fimbria is to be raised from the hippocampal gyrus, and there will be seen in the interval between them a free notched edge of grey matter (Fig. 84). This is the **fascia dentata**. It passes as far forwards

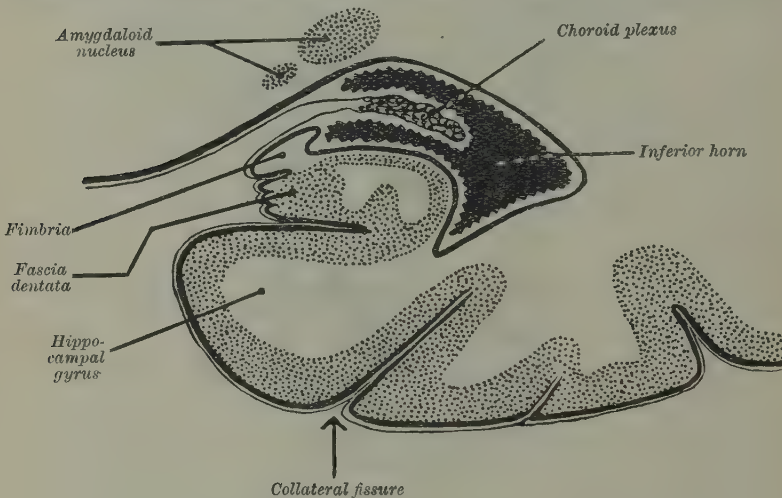


FIG. 84.

*Diagram of a vertical section through the inferior horn of the lateral ventricle.* The hippocampus is the area on the floor of the ventricle below the choroid plexus, and along the medial edge of which are the fimbria and the fascia dentata; below and medial to it is the hippocampal gyrus.

as the uncus of the hippocampal convolution, into the cleft of which it appears to run, while posteriorly, round the splenium of the corpus callosum, it is continued into the gyrus supracallosus (p. 233). The fascia dentata has already been stated to be part of the olfactory area of the hemisphere (p. 230). The roof of the inferior horn can also be studied, and in it the tail of the caudate nucleus and the stria terminalis are to be traced forwards to the amygdaloid nucleus, which is to be sought in the anterior part of the roof (p. 237).

The central part of the corpus callosum, which is still in position, should be pared away at its edges until the **septum**

**pellucidum** and the **fornix** are seen as well as is possible. The septum pellucidum should then be examined again on the medial face of the divided brain. It is triangular in shape and fills the interval between the corpus callosum above and the fornix below, to both of which it is attached (Fig. 78). The narrow middle strip of the corpus callosum is now to be removed. It should be cut across behind the genu and gently raised backwards, the upper


Fig. 85.

*Dissection of the fornix from above.* The corpus callosum has been cut across at the genu and the splenium and the intervening portion removed. The septum pellucidum is seen in front and behind it the upper surface of the fornix; from below the edges of the fornix the choroid plexuses project into the lateral ventricles.

edge of the septum pellucidum being separated from its lower surface. Behind the septum pellucidum, the corpus callosum covers and is connected to the fornix, but it should be removed from it as far back as the splenium. The upper edge of the septum pellucidum is then to be clipped with scissors, and in this way the two laminæ of which it is formed and the cleft between them will be shown (Fig. 85).

The **septum pellucidum** can now be seen to be a thin vertical partition which intervenes between, and forms the medial walls of, the anterior

horns and the front parts of the bodies of the lateral ventricles (Fig. 85). It consists of two thin laminæ separated by a narrow cleft named the cavum septi pellucidi, which varies very much in its size in different brains. It is a completely closed space, communicating neither with the ventricles nor with the exterior.

A considerable part of the **fornix** can now be seen from above (Fig. 85) and if at the same time it be examined on the medial surface of the sectioned hemisphere (Fig. 76) its form and relations

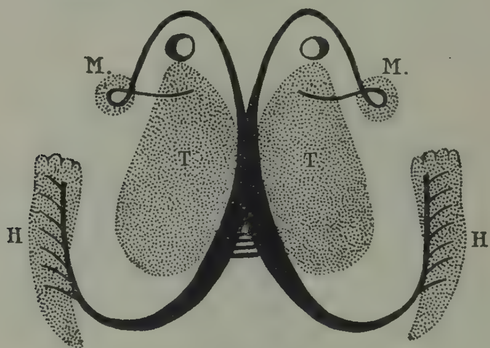


FIG. 86.

*Diagram of the form and connections of the fornix.* The fornix (in solid black) commences behind on the hippocampus (H) as the fimbria which lies on its medial edge and the alveus which is spread over its surface. As the posterior pillar it curves round the back of the thalamus (T) and comes into close contact with the band of the opposite side, some decussation of fibres taking place (horizontal lines). The body of the fornix divides in front into the two anterior columns, each of which passes in front of the foramen of Monro (a black circle between it and the anterior end of the thalamus) and ends in the corpus mammillare (M). The corpus mammillare is connected to the anterior end of the thalamus.

will be easily understood. On the medial view it can be seen to be a highly arched structure. It commences posteriorly as a continuation of the **fimbria** of the hippocampus, and arches forwards below the corpus callosum to which it is adherent behind but from which it is separated in front by the septum pellucidum. In this part of its course, as seen from above, it comes into close contact with the fornix of the opposite side, and some decussation of fibres takes place between the two. Anteriorly the two parts again separate and pass downwards to the base of the brain to end in the corpora mammillaria.

The **fornix** may be described, for purposes of topography, to consist of a central part or body and two anterior and two posterior columns or

pillars into which the body divides (Fig. 86). The **body** is triangular in shape, being narrow and rounded in front and broad and flattened behind. Its upper surface is adherent to the under surface of the back part of the corpus callosum but in front of this it is attached to the lower edge of the septum pellucidum. On each side the edge of this part of the fornix projects into the body of the lateral ventricle in the form of a sharp margin from under which the choroid plexus emerges (Fig. 85). The lower surface rests on the velum interpositum as will be

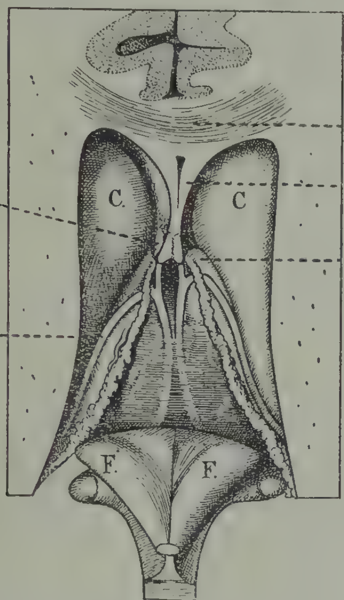


Fig. 87.

*Dissection of the velum interpositum from above.* The fornix has been cut across and its back part (F.F.) thrown backwards from the upper surface of the velum interpositum. In the velum are seen the veins of Galen. The foramen of Monro lies between the anterior column of the fornix and the anterior end of the thalamus. C.C. Caudate nuclei.

seen when it is reflected. The **anterior columns** are two rounded strands which diverge only slightly from one another and pass downwards to the base of the brain. In its course each anterior column lies in front of the foramen of Monro, of which it forms the anterior boundary, and then on the lateral wall of the third ventricle. Its ending in the corpus mammillare, and the connection of this body with the anterior end of the thalamus, will be dissected later. The **posterior columns** are flattened bands and diverge widely from each other as they sweep backwards and downwards. Each crus passes round the posterior end of the thalamus, and then enters the inferior horn of the lateral ventricle where, as the fimbria, it lies on the hippocampus and spreads as the alveus over its surface.

The fornix belongs to the olfactory part of the brain, being formed mainly of longitudinal fibres linking together the different parts of the olfactory areas of the hemisphere and connecting them to the thalamus. In the anterior part of the interval between the posterior columns, however, there may be seen transverse fibres which cross from one side of the fornix to the other and form a commissural tract between the two sides.

The body of the fornix is to be cut across at the level of the foramen of Monro, and the posterior part is to be raised and turned backwards. This dissection will expose the upper surface of the **velum interpositum** (Fig. 87). This is a two-layered fold of pia mater which lies between the body of the fornix above and the upper surface of the thalami and the roof of the third ventricle below (Fig. 82). It is triangular in shape, the anterior pointed end being placed at the foramen of Monro and the base below the splenium of the corpus callosum. The edges of the fold contain the **choroid plexuses** of the bodies of the lateral ventricles, while between the two layers of which it is formed there are the **internal cerebral veins** (of Galen) and some subarachnoid trabecular tissue (Fig. 87).

The two layers of the **velum interpositum** separate from one another at its base, the upper passing on to the splenium of the corpus callosum and the lower over the dorsal surface of the mid-brain (corpora quadrigemina). The **choroid plexus** consists of convoluted blood vessels arranged in little tufts and enclosed within the folds of the pia mater. It projects into the body of the lateral ventricle from the edge of the velum interpositum, but is covered by the ependymal lining which excludes it from the cavity (Fig. 82). Anteriorly, at the foramen of Monro, the choroid plexus becomes smaller and is continuous with the plexus of the opposite side across the middle line; while posteriorly it is continuous with the choroid plexus of the inferior horn of the ventricle.

The fissure on the medial wall of the hemisphere through which the choroid plexus is invaginated into the lateral ventricle is named the **choroidal fissure**. It is a narrow ⊃ - shaped slit, the upper part leading to the body of the ventricle and the lower into the inferior horn. As may be seen on the medial surface of the brain, it is bounded on its convex side by the fornix and its continuation the fimbria, while in the concavity between its two limbs lie the thalamus and the caudate nucleus. As the choroid plexus enters the fissure it pushes the ependymal lining of the ventricle before it.

The most conspicuous blood vessels in the velum interpositum are the **internal cerebral veins** of Galen (Fig. 87). They are two in number and run backwards, one on either side of the middle line. In front each is formed, at the foramen of Monro, by the union of the vena terminalis (p. 235) and a large vein which issues from the choroid plexus; while posteriorly the two veins of Galen unite to form the **great cerebral vein** of Galen which opens into the straight sinus (p. 131).

The vena terminalis is to be cut as it enters the apical part of the velum interpositum, and this membrane is then to be turned

backwards; it is easily done by grasping the anterior end with forceps. The whole of the upper surface of each **thalamus** is now exposed and, in the interval between the thalami, the **third ventricle** is opened (Fig. 88). The roof of the third ventricle is a simple layer of ependymal epithelium which is adherent to the under surface of the velum interpositum; it is torn away, therefore, when that membrane is reflected. Behind the posterior end of the ventricle care must be taken to separate the **pineal body** from the

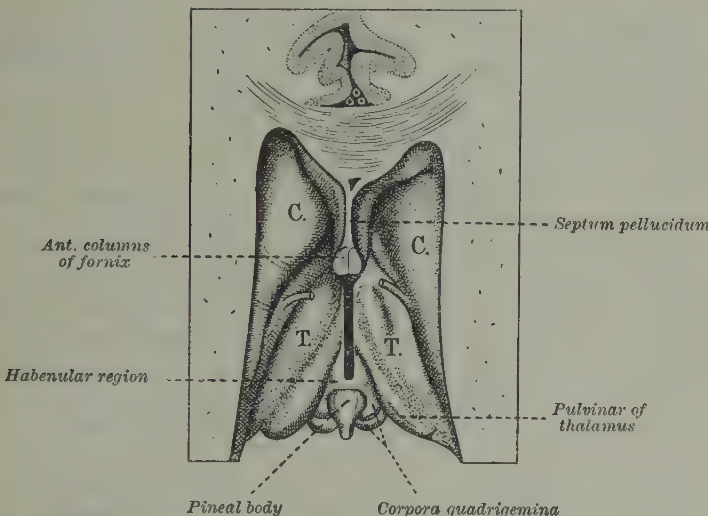


FIG. 88.

*Dissection of the upper surface of the thalami* (T.T.) *and exposure of the third ventricle (between them) from above.* C.C. Caudate nuclei.

tissue of the velum in which it lies, and with which it is easily pulled away. This body having been secured, however, the velum is to be removed, and on the dorsal surface of the mid-brain the **corpora quadrigemina** are to be exposed (Fig. 88).

The **thalamus** is to be very carefully studied, not only in the surface view of the present dissection, but also on the medial face of the divided brain and in vertical sections of the separated hemisphere. As seen from above (Fig. 88) it is a large ovoid mass of grey matter, placed obliquely so that the anterior ends of the two thalami are close together and the posterior ends more widely apart. The thalami form the lateral walls of the third ventricle but they also extend for some distance behind that cavity, and in

the interval between their posterior parts lie the corpora quadrigemina and the pineal body (Fig. 88). As seen in the vertical sections (Fig. 89), the thalamus appears embedded in the substance of the hemisphere, its lateral and under surfaces being applied to other parts of the brain; but it is free above where it appears on the floor of the lateral ventricle and on the medial side where it forms the wall of the third ventricle. It is convenient, therefore, to describe these four surfaces separately.

The **anterior** end of the thalamus, often called the anterior tubercle, is narrow and pointed. It projects into the lateral ventricle and forms the posterior boundary of the foramen of Monro (Fig. 87). The **posterior** end is enlarged and prominent and overlaps the lateral parts of the corpora quadrigemina. On its medial side there is a distinct rounded prominence named the **pulvinar**, and below and to the lateral side of this there is a smaller oval swelling which is called the **lateral geniculate body** (Fig. 88). The **lateral surface** of the thalamus, as seen in section, is applied to a thick mass of white matter called the **internal capsule**, while the **inferior surface** rests on parts which form the hypothalamus; this, and the internal capsule, will be studied later. The **superior surface** is slightly convex. On the lateral side it is separated from the caudate nucleus by the groove which contains the stria terminalis and the vein of the corpus striatum, while on the medial side it is separated from the medial surface by a prominent ridge named the **tænia thalami**. It is along this ridge that the epithelial roof of the third ventricle is attached to the thalamus. Deep to the tænia and accentuating it there is a longitudinal strand of white fibres named the **stria medullaris**, which can be followed backwards into a raised white band, the **habenula**. The habenula divides posteriorly into two parts, one of which becomes continuous with the pineal body while the other passes to the opposite side, forming the habenular commissure (Fig. 88). The upper surface of the thalamus thus defined, is divided into two parts by a shallow oblique groove which runs from behind forwards and medially; it corresponds to the lateral free edge of the body of the fornix (Fig. 88). The lateral area forms the medial part of the floor of the lateral ventricle, with the ependyma of which it is covered, while the medial area is covered by the velum interpositum and takes no part in the formation of the walls of either the lateral or third ventricles (Fig. 82). The **medial surface** forms the upper part of the lateral wall of the third ventricle and is usually connected to the corresponding surface of the opposite thalamus by a flattened grey band named the **middle commissure**.

The structure of the thalamus will be studied when it is sectioned horizontally, for then its connections can be more easily described.

The **pineal body** is a small, conical, dark coloured body about the size of a cherry-stone which projects behind the third ventricle and lies in the interval between the superior corpora quadrigemina (Fig. 88). It is enveloped by the lower layer of the velum interpositum. The apical part of the body, directed backwards, is free, while the broad basal part which is directed forwards is attached by a hollow stalk into which the third ventricle is continued in the form of a pointed recess. The stalk is thus divided into dorsal and ventral layers, the former of which is continuous with the habenula, while the latter is folded round the posterior commissure. The structure of the pineal body cannot be

examined in the dissecting-room, but the student should make sections of it to find the particles of calcareous matter (brain sand) which are present in it.

The **posterior commissure** is a narrow cord-like band of white fibres which crosses the middle line immediately below the base of the pineal body. The connections of its fibres are not yet fully understood.

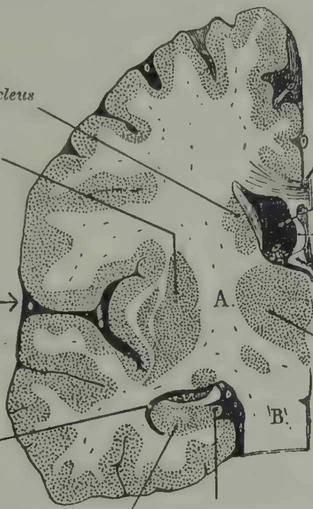


FIG. 89.

*Vertical section through the thalamus.* In the roof of the inferior horn of the ventricle the tail of the caudate nucleus is seen, and on the lateral side of the lenticular nucleus, and continuous with it below, is an area of grey matter which is the claustrum.

A. Internal capsule. B. Crus cerebri.

The **third ventricle** is a narrow, deep cleft which lies in the middle line between the two thalami, and as seen from above and on the medial face of the sectioned brain extends from the pineal body behind to the lamina terminalis and the anterior commissure in front. It communicates anteriorly with the lateral ventricles through the interventricular foramen of Monro, the two diverging limbs of which, as seen from above, pass laterally between the anterior columns of the fornix and the anterior tubercles of the thalami. It communicates posteriorly with the fourth ventricle through a narrow channel, the **cerebral aqueduct** of Sylvius, which tunnels through the mid-brain (Fig. 76). The opening of this canal is to be seen on the medial section immediately below the posterior commissure.

The walls of the **third ventricle** should now be considered. The **roof** consists of a very thin epithelial layer which stretches from the tænia thalami of one side to that of the other. It is covered by and adherent to the under surface of the velum interpositum with which it is always torn away. From the velum interpositum two **choroid plexuses**, one on each side of the middle line, project downwards and invaginate the roof into the cavity (Fig. 82). The **floor** is formed mainly by the structures which form the **hypothalamus**. These structures, from before backwards, are the optic chiasma, the tuber cinereum and the infundibulum, the corpora mammillaria, and the region of the posterior perforated space, all of which were previously described to lie in the interpeduncular fossa (p. 208). The **lateral walls** are formed by the medial surfaces of the thalami, and in front of the foramen of Monro the anterior columns of the fornix are to be seen embedded in the grey matter on the sides of the ventricle. The **anterior boundary** is formed by the lamina terminalis which runs downwards to the upper edge of the optic chiasma from the anterior commissure (Fig. 76).

The outline of the third ventricle thus bounded is very irregular (Fig. 76). It should be examined on the medial face of the sectioned brain where the recesses which lead from it can be seen. From the anterior part of the floor there is a deep funnel-shaped recess leading down into the infundibulum of the pituitary gland, and above this another recess passes in front of the optic chiasma. From the posterior wall two recesses pass backwards ; one, the pineal recess, passes into the stalk of the pineal body above the posterior commissure, the other is placed above this and is named the suprapineal recess. Its walls are epithelial and it is usually destroyed in an ordinary dissection.

At this stage of the dissection the **anterior column** of the **fornix** should be traced downwards to the **corpus mammillare** along the side wall of the third ventricle on the sectioned brain. The dissection is not difficult, for the column is a distinct rounded bundle and is easily isolated. The fibres of the fornix end in the corpus mammillare, but if this body be carefully dissected away the appearance presented is as if the whole column looped on itself and passed upwards to the anterior end of the thalamus (Fig. 86). This tract, the **mammillo-thalamic tract**, is, however, a new bundle, its fibres arising from the mass of grey matter which constitutes the mammillary body. Through the mammillo-thalamic tract the olfactory areas of the hemisphere, from which the fornix comes (p. 240), are brought into association with the nerve paths of the other senses entering the thalamus.

## THE MID-BRAIN

The further study of the cerebral hemisphere must be postponed until the **mid-brain** is examined. It is a short, thick portion, about three-quarters of an inch long, and connects the cerebral hemispheres in front with the pons, medulla, and cerebellum behind. Its superficial characteristics are to be examined first. It consists

of two parts: (1) A dorsal part, the **lamina quadrigemina**, which is completely covered in the undissected brain, and, as may be seen on the sectioned specimen, is overlaid by the splenium of the corpus callosum (Fig. 76); and (2) a ventral part, formed by the two **crura cerebri**, to be seen on the base of the brain (Fig. 72).

The **lamina quadrigemina** should be brought into view by pulling the cerebellum as far back as possible. The four rounded eminences into which it is divided, the **corpora quadrigemina**, two **superior** and two **inferior**, are readily recognised; the superior are larger and broader but not so well defined as the inferior pair. The corpora quadrigemina are separated from one another by a cruciate sulcus. The longitudinal limb of this sulcus lies in the middle line. At its anterior end it broadens considerably and has resting in it the pineal body, while from its lower end a narrow band of white fibres, the **frenulum veli**, passes on to the **anterior medullary velum**. The **trochlear** (fourth cranial) **nerves** are attached one on either side of this band, and care should be taken to secure them at once, and to follow them round the lateral sides of the mid-brain and on to its ventral surface where they were previously found (p. 220).

From the lateral side of each of the corpora a very definite band of white matter, named the **brachium**, is prolonged upwards and forwards under the pulvinar of the thalamus. The brachia of each side are separated from one another by a continuation of the transverse limb of the cruciate sulcus. When followed laterally the inferior brachium will be seen to pass under a small but sharply defined oval eminence, which lies under cover of the pulvinar of the thalamus; it is named the **medial geniculate body**. The superior brachium runs between this body and the pulvinar and in part appears to enter the lateral geniculate body and in part to be directly continued into the **optic tract** (Fig. 90).

The central connections of the **optic nerves** may well be considered now. The optic nerve arises in the retina and passes backwards to the chiasma. At the chiasma the fibres which arise in the medial (nasal) side of the retina decussate with the corresponding fibres of the opposite side; the lateral (temporal) fibres take no part in the decussation. The **optic tract**, therefore, which commences at the chiasma, contains fibres which arise in the lateral side of the retina of the same side and fibres which arise in the medial side of the retina of the opposite side. From the optic chiasma it passes backwards and laterally and winds dorsally round the crus cerebri towards the corpora quadrigemina.

At its dorsal end it divides into two roots. The medial of these enters the medial geniculate body, while the lateral root is continued partly into the superior brachium, and through it reaches the superior corpus quadrigeminum, and partly into the lateral geniculate body and the pulvinar of the thalamus (Fig. 90). These parts, the superior corpus, the lateral geniculate body and the thalamic pulvinar, in which the fibres of the optic tract end, constitute the **lower visual centres**; and from them there is a great radiation of fibres towards the higher visual centres in the

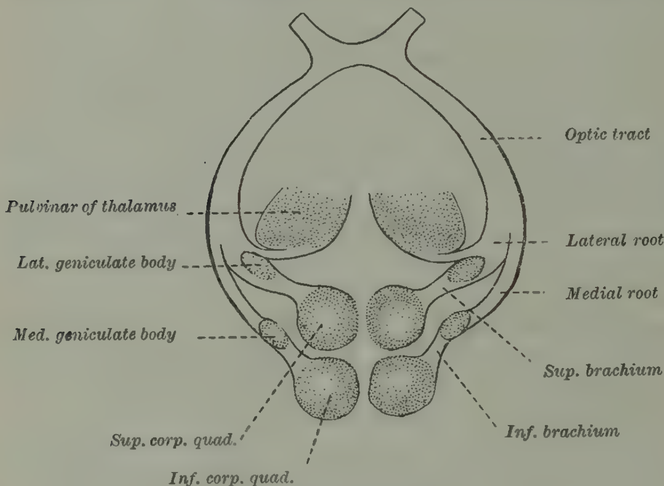


FIG. 90.

*Diagram of the central connections of the optic tracts.*

cortex round the calcarine fissure on the medial side of the occipital region of the cerebral hemisphere.

The fibres of the **medial root** of the **optic tract** end in the medial geniculate body. They do not arise from the retina in front but in the chiasma cross to the opposite side and thus form a commissural tract (of Gudden) linking together the two medial geniculate bodies.

The **crura cerebri**, when viewed from below (Fig. 72), appear as two large strands which emerge close together from the upper margin of the pons and diverge as they pass upwards to the cerebral hemispheres. Winding round each peduncle as it enters the hemisphere is the optic tract. The surface of the crura is streaked in a longitudinal direction, indicative of the direction of the fibres which form their substance. On the medial side of each crus, which looks into the interpeduncular fossa, there is

a longitudinal sulcus from which the roots of the **oculo-motor** (third cranial) **nerve** emerge; the sulcus is thus named the **oculo-motor sulcus.**

The mid-brain should now be cut through transversly at the level of the inferior corpora quadrigemina so that the structure of its interior may be examined. There can be distinguished at once on such a section (Fig. 92): (1) The **cerebral aqueduct** of Sylvius, which tunnels through the mid-brain and connects the third ventricle in front with the fourth ventricle behind. It lies

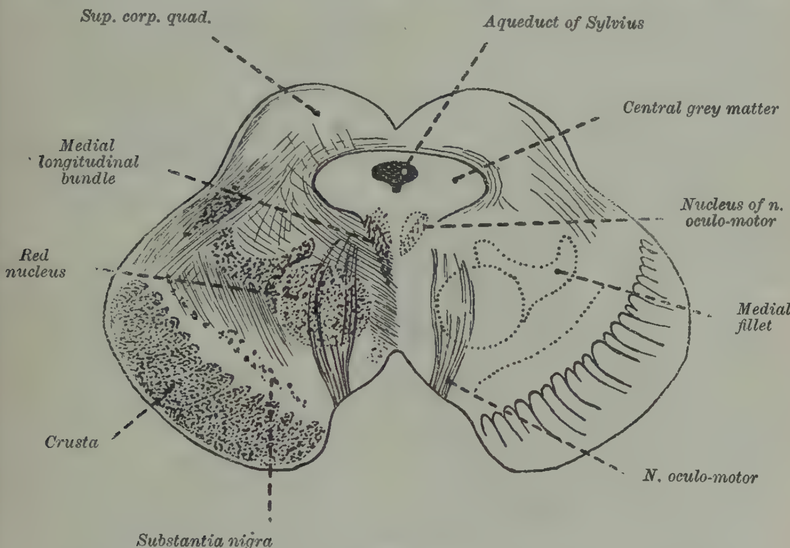


Fig. 91.

*Diagram of a transverse section through the superior corpora quadrigemina.*

much nearer the dorsal surface, and on transverse section it appears as a small triangular or T-shaped opening. The aqueduct is surrounded by a thick layer of grey matter, the **central grey matter**, which can usually be distinguished with the naked eye. The area of the mid-brain which lies above the aqueduct is the lamina quadrigemina and that below belongs to the crura cerebri. (2) The **substantia nigra** is a conspicuous darkly pigmented layer of grey matter, crescentic in outline on transverse section, and divides the crus into a dorsal part, the **tegmentum**, and a basal part, the **crusta**. The surface of the substantia nigra towards the tegmentum is concave and smooth but the opposite surface is convex and highly irregular, for numerous small pointed processes

pass from it into the crusta. Its margins come to the surface at the oculo-motor groove on the medial side and at a shallow depression, the lateral sulcus, on the lateral side. (3) The **crusta** of each side is crescentic in outline and is quite separated from that of the opposite side (Fig. 92). It is composed almost entirely of longitudinal fibres which arise from the cells of the cerebral cortex and descend through the mid-brain. It is not possible to distinguish the different tracts, but the student should remember that those which lie in the middle three-fifths are derived from

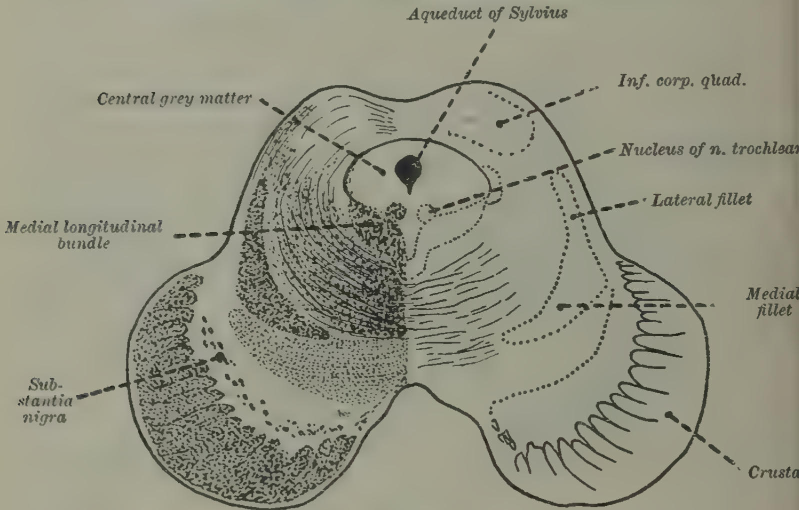


Fig. 92.

*Diagram of a transverse section through the inferior corpora quadrigemina.*

the cells of the motor cortex (precentral convolution) and constitute the great motor (pyramidal) path. The fibres in the medial fifth are those of the fronto-pontine tract and those in the lateral fifth the temporo-pontine tract; they originate in the frontal and temporal regions of the cortex and end in the nuclei of the pons. (4) The **tegmentum** extends across the whole width of the mid-brain, there being only a slight median raphe indicating its division into lateral halves. It is in no way separated from the lamina quadrigemina above.

The study of the mid-brain is to be completed by examining Figs. 91 and 92, which are of transverse sections through the superior and inferior corpora quadrigemina and show the main features of their structure as seen on prepared specimens. It is not possible to see all of these details in a dissecting-room section,

but the student should at least make similar sections and seek them with a hand lens.

The **tegmentum** is composed of a mixture of grey matter and white fibres, forming what is called a "formatio reticularis." The principal mass of grey matter is the **red nucleus** which lies in the anterior part of the mid-brain and in sections at the level of the superior corpus appears as a circular mass slightly reddish in colour (Fig. 91). Most of the fibres of the brachium conjunctivum end in it, while the axons of the majority of its cells cross the middle line and are continued downwards as the rubro-spinal tract. The white fibres of the tegmentum are both longitudinal and transverse in direction and are for the most part gathered together to form well-marked bundles (or paths or tracts). The **medial longitudinal bundle** is one of these (Fig. 91). It forms a compact mass almost vertical in direction on either side of the median raphe below the central grey matter round the cerebral aqueduct. Its connections are imperfectly known but it consists largely of fibres which link together the nuclei of the mid and hind brains. The **brachia conjunctiva** (superior cerebellar peduncles) are derived from the cerebellum and converge as they pass up towards the mid-brain; stretching between them there is a thin lamina, the superior medullary velum. They sink below the inferior corpora quadrigemina and in a section through these bodies appear as two white semilunar tracts below the median longitudinal bundles. They decussate with one another across the middle line and end mainly in the red nuclei. A third bundle which should be sought is the great ascending path of the general cutaneous sensations; it is named the **medial fillet** (or lemniscus) (Fig. 91). It forms a flattened tract and lies just dorsal to the substantia nigra. There is another ascending path consisting of fibres derived from the nuclei of the cochlear division of the auditory nerve and conducting, therefore, impulses of hearing; it is named the **lateral fillet** (Fig. 92). It lies close to the surface of the tegmentum opposite the lateral sulcus, from which its fibres emerge and pass into the inferior corpus quadrigeminum. The corpora quadrigemina consist of grey matter; into the superior of them there was previously traced the optic tract and into the inferior there has now been followed the lateral fillet which may be conveniently termed the auditory tract.

The mid-brain may now be summarised in the following terms: (1) It serves as a pathway for the great motor and sensory tracts between the cerebral hemispheres and the lower parts of the central nervous system. (2) It contains in the superior and inferior corpora quadrigemina the lower centres for sight and hearing. (3) The nuclei of the third and fourth cranial nerves lie in the grey matter on the floor of the cerebral aqueduct. (4) The red nucleus, round which the efferent fibres of the cerebellum (brachium conjunctivum) end and from which the rubro-spinal tract arises, is embedded in the tegmentum.

## THE BASAL GANGLIA OF THE CEREBRAL HEMISPHERE

The caudate and the lenticular nuclei of the cerebral hemisphere are now to be examined, and while this is being done it is possible

to study also the structure of the **thalamus** and a series of related parts of the hemisphere which are of great clinical importance. The study is to be made by cutting a succession of thin horizontal sections through the parts below the level of the floor of the body of the lateral ventricle; and this can be most conveniently done on the hemisphere in which the occipital and temporal horns of the ventricle are not opened. The vertical sections which were made through the detached hemisphere of the other brain are also to be used in the study; and if it has not already been made, one of these sections should be cut so as to pass through the anterior commissure. By examining both sets of sections and piecing together the information to be gained from them, the form and relations of the caudate and lenticular nuclei and the **internal capsule** can be learned.

The **caudate nucleus**, a mass of grey matter, has already been examined in connection with the lateral ventricle. It is a highly arched, ⊃- or horseshoe-shaped structure, the upper and anterior part of which is expanded as the "head" of the nucleus, while the remainder, narrowing rapidly, forms the long attenuated "tail." The head of the nucleus projects into the anterior horn of the lateral ventricle, of which it forms the floor (Fig. 81), and is carried backwards on the floor of the body of the ventricle on the lateral side of the thalamus, from which it is separated by the groove containing the stria terminalis (Fig. 82). Both parts are crossed by veins of some size which end in the vena terminalis. The tail of the nucleus turns downwards and then passes forwards in the roof to the inferior horn of the ventricle, in which it is prolonged to the amygdaloid nucleus (Fig. 84). The ventricular (convex) surface of the nucleus is thus easily examined; the deep (concave) surface, as seen in the sections, is embedded in the white substance of the hemisphere and for the most part is related to the medial side of the internal capsule (Fig. 89).

The **lenticular nucleus** is almost completely embedded in the white matter of the hemisphere on the lateral side of the caudate nucleus and the thalamus; it can only be seen, therefore, in sections of the brain (Fig. 89). In horizontal sections it has the appearance of a biconvex lens, the lateral surface being flatter than the medial surface, while in vertical sections it is more or less triangular, the apex pointing towards the interval between the caudate nucleus and the thalamus. It is shorter than the caudate nucleus and does not extend so far forwards, but the anterior parts of the two nuclei are connected together by bands of grey matter which cross the anterior part of the internal capsule

(Fig. 81). Owing to the ribbed appearance presented by a section through these connections, the two nuclei have been named the corpus striatum. The lateral surface of the lenticular nucleus is related to a thin lamina of white matter named the **external capsule**, lateral to which there is a thin layer of grey matter named the **claustrum**. The medial surface of the nucleus is applied to the **internal capsule**. In a vertical section through the middle of the nucleus, it is seen to be divided into three parts by two white medullary laminæ. The lateral and largest part is named the putamen, while the two medial zones together form the globus pallidus.

The **claustrum** (Fig. 89) is a thin lamina of grey matter embedded in the white matter between the lenticular nucleus and the island of Reil, with the latter of which it corresponds in extent. Its medial surface is smooth but its lateral surface presents ridges and furrows which correspond with the convolutions and fissures of the insula.

The **internal capsule** (Fig. 89) is the broad band of white matter which intervenes between the lenticular nucleus on the lateral side and the caudate nucleus and the thalamus on the medial side. In horizontal sections, especially, it is seen to be bent upon itself opposite the interval between the caudate nucleus and the thalamus. The apex of the bend, which is pointed medially, is named the **genu**. The part of the capsule which lies anterior to the genu, and between the lenticular and caudate nuclei, is called the **anterior limb**; the part which lies posterior to the genu between the lenticular nucleus and the thalamus is named the **posterior limb**. The anterior limb is broken up in front by the bands of grey matter which pass between the head of the caudate nucleus and the anterior part of the lenticular nucleus, but the posterior limb is a solid mass of white nerve fibres, and as seen in vertical sections (Fig. 89) is directly continuous below with the crus cerebri of the mid-brain. Among the fibres of the posterior limb are those of the great **motor** (pyramidal) and **sensory tracts**. The former, originating in the motor convolution of the cerebral hemisphere, pass through the capsule to the parts below, occupying the region of the genu and the anterior two-thirds of the posterior limb; the latter, consisting of fibres derived from the thalamus which are concerned with the tactile sensations, and of fibres from the lower visual and lower auditory centres of the mid-brain (p. 251), radiate upwards through the posterior third of the posterior limb to the cortical centres of the hemisphere.

The sections which have been made through the **thalamus** show it to be composed chiefly of grey matter, which is incompletely divided into

three parts, an anterior, a medial, and a lateral, by a white medullary layer. It is the end station of the ascending (sensory) paths of the mid-brain and of a part of the optic tract, and receives in front the mammillo-thalamic tract (p. 246), and from the cells of its substance numerous groups of fibres arise and radiate to almost every part of the cerebral cortex.

## THE HIND-BRAIN

The parts which form the hind-brain are grouped round the **fourth ventricle**, the **pons** and the **medulla oblongata** lying anterior to it and forming its floor and the **cerebellum** posteriorly and in its roof. The student has at his command two specimens of these parts, one in which the hind-brain is intact and one in which it is divided longitudinally in the middle line. On the intact specimen the external features of the three parts should be studied.

The ventral surface alone of the **pons** can be seen; its dorsal surface faces into and forms the upper part of the floor of the fourth ventricle (Fig. 76). The ventral surface forms a marked prominence on the base of the brain, convex from side to side and to a less extent from above downwards (Fig. 93). From its upper edge the **crura cerebri** emerge, one on either side of the middle line, while below it is separated from the front of the medulla by a transverse groove, in which the **abducent, facial,** and **auditory nerves** appear (Fig. 93). The surface of the pons is transversely striated, showing that it consists, superficially at least, of bundles of transverse fibres. On each side these transverse fibres are gathered together to form a compact mass, the **brachium pontis** (middle cerebellar peduncle), which passes backwards and laterally and sinks into the cerebellum. In the middle line of the pons there is a shallow groove for the lodgment of the basilar artery, and on either side of it an eminence produced by the motor (pyramidal) tract passing downwards in the substance of the pons (Fig. 95). Lateral to these eminences, the trigeminal nerves are attached near the upper border of the pons (Fig. 93).

The external form of the **medulla oblongata** has already been partially studied (p. 207). It is a conical structure, about one inch in length, its broad end being directed upwards towards the pons, while its narrow end is continuous with the spinal cord at about the level of the foramen magnum. On its anterior surface in the middle line there is the **anterior fissure,** interrupted at its lower part by the **decussation** of the **pyramids** and then continued into the anterior fissure of the cord; it ends above at the lower border of the pons in the **foramen cæcum.** On each side of the fissure is the swelling of the **pyramid** (Fig. 93). Its upper end, as

it issues from the pons, is somewhat constricted, and between it and the pons the abducent nerve appears; while on its lateral side the fila of the hypoglossal emerge in the groove between it and the olive (Fig. 93). Each pyramid contains the continuation of the motor tract, which when traced downwards divides into two parts. The greater number of fibres cross to the opposite side of the spinal cord, the crossing of the two sides forming what has been termed the decussation of the pyramids; the remaining fibres do not cross but continue downwards in the anterior column of the cord. The

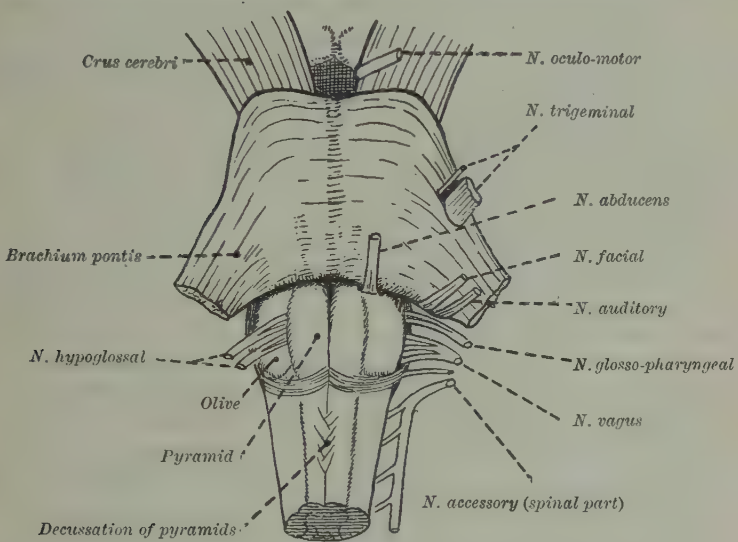


FIG. 93.

*The anterior surface of the pons and the medulla oblongata.* The external arcuate fibres are shown.

pyramid of one side of the sectioned brain should be divided about its middle and the two parts carefully raised. In this way the passage of the upper part from the pons and the division of the lower part at the upper end of the spinal cord will be clearly demonstrated.

Lateral to the pyramid, in the interval which is bounded in front by the fila of the hypoglossal nerve and behind by the fila of the glosso-pharyngeal, vagus and accessory nerves, there is the smooth oval prominence of the **olive**, and below the olive an area which appears to be directly continuous with the lateral column of the spinal cord (Fig. 93). It contains, however, only part of the fibres of the lateral column of the cord, and these when

continued upwards dip beneath the olive and disappear from the surface. Between the olive and the pons there is a groove in which the roots of the facial nerve are attached.

On the posterior surface of the medulla, which is to be exposed as well as possible by raising the cerebellum, the **posterior fissure** is seen only in the lower part; for in the upper part the central canal of the lower part, which is continuous below with the central canal of the cord, expands into the cavity of the fourth ventricle. The lips of the posterior fissure, therefore, are pushed aside, and in the interval between them the roof of the ventricle appears (Fig. 94). On each side of the posterior fissure there are two distinct longitudinal bands, the **tractus** (or fasciculus) **gracilis** medially and the **tractus cuneatus** laterally (Fig. 94), which are the direct upward prolongations of the posterior columns of the spinal cord (p. 54). These tracts are at first vertical but when followed upwards those of the two sides diverge from each other along the lateral walls of the lower part of the fourth ventricle; and there each of them ends in a slight elongated swelling. The swelling on the tractus gracilis is named the **clava** and that on the tractus cuneatus the **cuneate tubercle** (Fig. 94); and it will be seen, when the medulla is sectioned, that both swellings are due to underlying nuclei of grey matter, the **nucleus gracilis** and the **nucleus cuneatus**, in which the fibres of the respective tracts end. A third elevation, the **tubercle of Rolando**, narrow below but wider above, lies between the tractus cuneatus and the fila of the accessory nerve. The upper part of the posterior surface of the medulla is formed by the **restiform body**, a thick, rope-like strand. The two bodies form the lateral boundaries of the lower part of the fourth ventricle; as they ascend they diverge from one another and finally turning backwards they enter the cerebellum, of which they form the inferior peduncles (Fig. 94). Near its termination each body is crossed posteriorly by several strands of fibres named the **striæ acusticæ** (Fig. 94). The restiform body appears to be the upward continuation of the tractus gracilis and tractus cuneatus, for it is not sharply marked off from them; but it contains no fibres which are directly prolonged into it from these tracts. Its constitution will be considered later, but at present one group of fibres should be followed into it. These are the **external arcuate fibres** (Fig. 94). They vary very greatly in their number in different specimens, in some being scarcely visible, in others forming an almost continuous layer over the pyramid and the olive. They emerge on the surface at the anterior fissure and in the interval between the pyramid and the olive and pass backwards to the restiform body.

The **cerebellum** has already been described to lie in the roof of the fourth ventricle (Fig. 76), and to be characterised by the closely-set parallel fissures which traverse its surface and extend a considerable distance into its substance. On the sectioned specimen the manner in which the cerebellum is thus divided into a series of leaf-like parts, the folia, is well shown (Fig. 76), and it is seen to be formed of a central core of white matter which extends into each of the folia, and a layer of grey matter which is spread over the surface. The appearance of branching which is thus produced has been named the **arbor vitæ**.

The cerebellum is ovoid in form, its greatest diameter being from side to side, but it is flattened from above downwards so as to have a superior and an inferior surface. It consists of a median portion which is named the **vermis** and two lateral expanded parts named the **hemispheres**, which are separated behind by a deep posterior notch and in front by a broad, shallow anterior notch. On the superior surface of the organ the division into these three parts is not well marked, the vermis forming only a slight median elevation; but on the inferior surface it lies at the bottom of a deep depression, the **vallecula cerebelli**, which intervene between the two hemispheres.

Certain of the fissures of the cerebellum are deeper and longer than the others, and have been used to subdivide the organ into parts which are termed **lobes**. One such fissure, the **great horizontal fissure**, which passes round the circumference of the cerebellum and cuts deeply into it, divides it into an upper and lower part; but at present it is of little importance, either morphological or clinical, to study in detail the further subdivision of the cerebellum into lobes.

The cerebellum is connected to the other parts of the brain by three large strands on each side, the **cerebellar peduncles**. They should be examined first on one half of the divided specimen on which they should be traced into the white matter of the organ by tearing away its substance at the great horizontal fissure. The **brachium pontis** (middle peduncle) is the largest. It is formed by the transverse fibres of the pons, and enters the cerebellum at the anterior end of the great horizontal fissure and on the lateral side of the other two peduncles (Fig. 94). The fibres it contains arise in the nuclei pontis of the opposite side (p. 261). The **restiform body** is the inferior peduncle. It carries into the cerebellum, in the main, fibres which are connected to the sensory parts of the spinal cord. The superior peduncles are the **brachia conjunctiva**. They are to be examined on the undivided specimen by pulling the cerebellum gently backwards from the mid-brain. They then appear as two large strands lying on the dorsal surface

of the pons, which converge as they proceed upwards and finally disappear under the inferior corpora quadrigemina (Fig. 94). They contain, in the main, fibres which arise in the cerebellum and end in the red nucleus of the mid-brain. They are connected together by the **superior medullary velum**, a thin white triangular lamina which stretches between their medial edges (Fig. 95). On the surface of the velum there is a small tongue-shaped process of the grey matter of the cerebellum, named the **lingula**, and issuing from it close to the inferior corpora quadrigemina and on either side of the frenulum veli (p. 247) are the two **trochlear nerves**.

Horizontal sections are now to be made through the cerebellum on that half of the divided brain which has not been torn, until there is exposed in the white matter a thin, waved lamina of grey matter; this is the **dentate nucleus**. It is placed rather nearer the upper than the lower surface, and is folded on itself so as to have a horse shoe shape, the opening of which is directed forwards and medially. The greater number of fibres which form the brachium conjunctivum issue from it.

The undivided specimen is now to be laid with the pons and medulla downwards. The cerebellum is to be divided in the middle line of the vermis from the posterior cerebellar notch towards the **fourth ventricle**, so that this cavity is opened through its roof. The two halves of the cerebellum are now to be pulled far enough apart to allow the dissector to look into the cavity and observe its general form. It is somewhat rhomboidal in shape (Fig. 94). Its pointed extremities are at its anterior and posterior ends where it is continued, respectively, into the cerebral aqueduct of the mid-brain and the central canal of the spinal cord, while on either side, from its lateral angles, there is a narrow **lateral recess** of the cavity prolonged over the upper surface of the restiform body (Fig. 94). The roof of the cavity, as has already been seen on the sectioned brain (Fig. 76), is formed by the superior medullary velum above, the white matter of the vermis of the cerebellum in the middle, and the **inferior medullary velum** below. The first two parts are easily recognised, but there may be difficulty in demonstrating the last.

The **inferior medullary velum** is a broad, thin, translucent layer of white matter which is continuous above with the white matter of the cerebellum. It forms only a small part of the roof of the ventricle for it soon ends in a ragged concave margin, and below this margin the roof of the lower part of the ventricle is formed by the thin ependymal lining membrane. It resembles, therefore, the roof the third ventricle, and like it, it is covered and strengthened by a layer of pia mater, which is named the **tela chloroidea** of the fourth ventricle. The tela is perforated over the lower pointed angle of the ventricle and at the apices of the lateral recesses, and through these openings the cavity of the ventricle

communicates with the subarachnoid space and cerebro-spinal fluid can pass from one cavity to the other. From the under surface of the tela two **choroid plexuses** project into the ventricle, invaginating the ependymal roof. At the lower part of the ventricle they lie parallel with one another close to the middle line (Fig. 96), but above they become horizontal, and are carried into the lateral recesses.

The peduncles of the cerebellum are to be cut through so that it may be removed. The floor of the ventricle, which is formed by the posterior surface of the pons above and of the medulla below, and the lateral boundaries of the cavity can now be examined (Fig. 94).

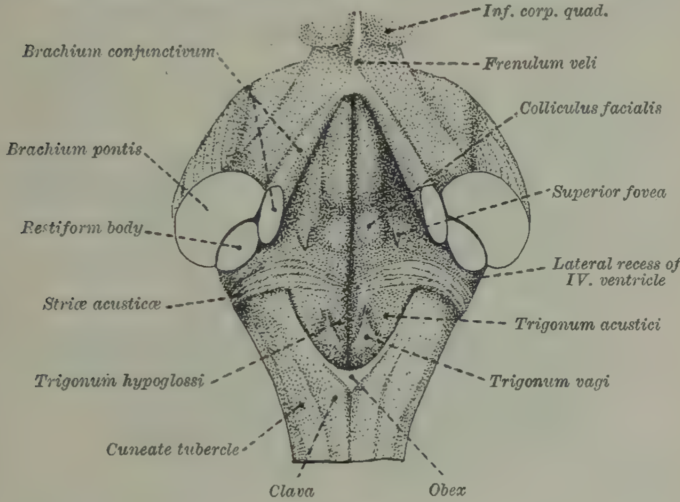


Fig. 94.

*Diagram of the floor and the lateral boundaries of the fourth ventricle.* The three cerebellar peduncles have been cut through on each side, and the cerebellum and the superior and inferior medullary vela have been removed.

The **lateral boundaries** of the fourth ventricle are formed, on each side from below upwards, by the clava, the cuneate tubercle, and the restiform body below, and by the brachium pontis and the brachium conjunctivum above (Fig. 94). Along the margins of the lower boundaries there will be seen the remains of the torn ependymal roof and two narrow white bands, named the **tæniæ**; these bands meet over the lower angle of the ventricle, and form a thin triangular fold named the **obex** (Fig. 94).

The **floor** of the fourth ventricle is rhomboidal in shape (Fig. 94). It is divided into lateral halves by a median sulcus, which is deeper below than it is above, and each half is again divided into upper and lower parts by strands of fibres, the **striæ acusticæ**, which pass from each of the lateral angles across the restiform body and the floor to the median sulcus (Fig. 94). The upper parts may be described as the dorsal surface of the pons, and the lower parts as the dorsal surface of the medulla. In the upper part there is on each side of the median sulcus the **eminentia teres** (eminentia medialis), the lower end of which, a

nodular prominence, is named the **colliculus facilis** (Fig. 94). It is bounded laterally by a sulcus (sulcus limitans) which expands below into a small triangular depression, the **superior fovea**. Along the lateral border of the upper part of the sulcus there is a narrow area named the **locus cœruleus** from its faint bluish colour; the colour is due to an underlying collection of pigmented cells, the substantia ferruginea. In the lower or medullary area there is, on each side of the middle line, a triangular depression, the **inferior fovea**, the apex of which is directed towards the striæ acusticæ (Fig. 94). The triangular area between the two limbs of the fovea is named the **trigonum vagi**, since part of the vagus and glosso-pharyngeal nuclei lie deep to it. Medial to the trigonum vagi, between it and the median sulcus, is the **trigonum hypoglossi** which

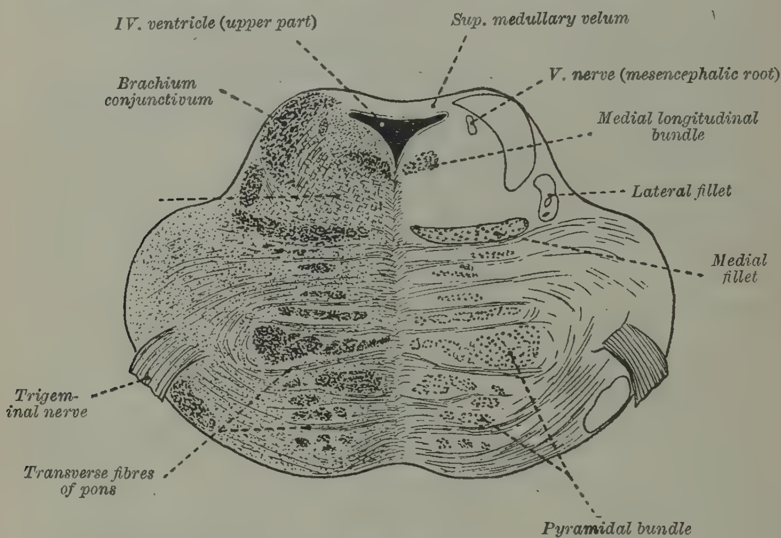


Fig. 95.

*Transverse section through the upper part of the pons.*

marks the position of the nucleus of the hypoglossal nerve, while lateral to the trigonum vagi and extending upwards into the pontine area is the **trigonum acustici**, under which lies part of the nuclei of the auditory nerve (Fig. 96). The medullary area of the floor of the ventricle, thus divided, is sometimes named the calamus scriptorius.

A series of transverse sections should now be made through the pons and medulla, for though little of the details of their structure can be learnt from dissecting-room specimens, yet their general outline and some of the important parts can be recognised. They should be compared with the sections made through the mid-brain.

A transverse section of the **pons** shows that it consists of two parts, an anterior and posterior (Fig. 95). The anterior is the larger part. It consists of a large number of bundles of transverse fibres intermingled with which there are bundles of longitudinal fibres; the latter are the fibres of the **motor** (pyramidal) **tract**, proceeding downwards from the

mid-brain to form the pyramids of the medulla. Scattered among these sets of fibres there are collections of grey matter forming the **nuclei pontis**, from which the transverse fibres arise. The posterior part of the pons is named the **tegmentum**. It is continuous above with the tegmental parts of the mid-brain (p. 249). On its dorsal surface there is a layer of grey matter which is spread over the floor of the fourth ventricle, and at the sides the brachia conjunctiva, semilunar in shape, are seen in section; between them the superior medullary velum roofs over the ventricle. A median raphe divides this part of the pons into two lateral parts, in each of which three bundles of longitudinal fibres should be sought (Fig. 95). (1) The **medial longitudinal bundle** lies close to the median plane immediately below the grey matter of the floor of the ventricle. (2) The **medial fillet** (or lemniscus) is a flat bundle placed between the anterior and posterior parts of the pons. (3) The **lateral fillet**, seen only in sections

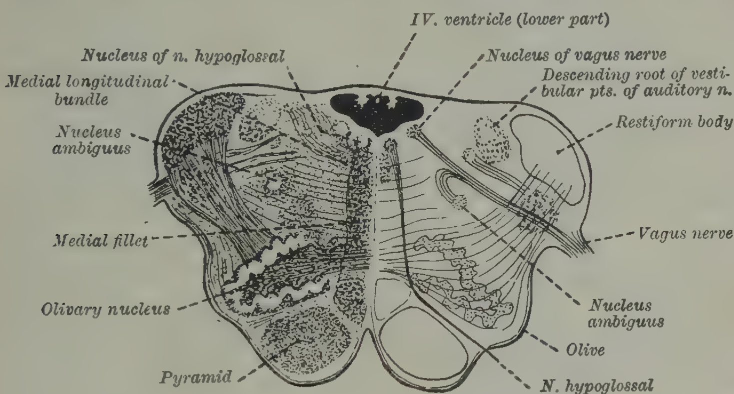


FIG. 96.

*Transverse section of the medulla oblongata through the middle of the olive.* The thickness of the roof of the ventricle is exaggerated; projecting from it are the two choroid plexuses.

through the upper parts of the pons, lies on the lateral side of the lower part of the brachium conjunctivum.

A section through the medulla oblongata at the level of the olive shows that it is divided into two lateral halves by a median raphe (Fig. 96). In each half there can be distinguished: (1) The **olivary nucleus,** which lies subjacent to the olivary eminence and appears as a thick waved line of grey matter folded on itself like a horseshoe, the opening being directed towards the median raphe. (2) The **motor** (pyramidal) **tract**, which forms the substance of the pyramid. It is continued from the scattered pyramidal bundles of the pons and in sections at a lower level the decussation of the majority of its fibres, at the decussation of the pyramids, should be seen. (3) The **medial longitudinal bundle** lies close to the median raphe in the posterior part of the medulla. (4) The **medial fillet** (or lemniscus), continued upwards into the pons, lies close to the median raphe immediately above the pyramid. It commences below in the **nucleus gracilis** and **nucleus cuneatus** of the opposite sides, and these little masses of grey matter should be sought in sections through the clava and the cuneate tubercle.

# INDEX

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